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COMPUTER PROGRAM TO PREDICT NOISE OF GENERAL AVIATION AIRCRAFT

FINAL REPORT AND USER'S GUIDE

by

J.A. MITCHELL
C.K. BARTON
L.S. KISNER
C.A. LYON

GARRETT TURBINE ENGINE COMPANY
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J.A. Mitchell, C.K. Barton, L.S. Kisner, C.A. Lyon

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Program Manager, Gerald Knip, Aircraft Propulsion Division
NASA Lewis Research Center, Advanced Programs Branch, Subsonic Missions Section
Cleveland, Ohio

16. Abstract
Program NOISE predicts General Aviation Aircraft far-field noise levels at FAA FAR Part 36 certification conditions. It will also predict near-field and cabin noise levels for turboprop aircraft and static engine component far-field noise levels.

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FOREWARD

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SECTION I

1.0 INTRODUCTION AND SUMMARY

During recent years, NASA has developed the General Aviation Synthesis Program, GASP, which allows an analyst to quickly perform parametric studies associated with the preliminary design of general aviation engine/airframe systems. Until now, GASP has lacked a detailed computer model for the prediction of turbojet-and turboprop-powered aircraft noise levels. Program NOISE fulfills that need. Although not currently integrated into GASP, NOISE is closely associated with GASP, and can utilize the results of a GASP design process as input.

Program NOISE predicts general aviation aircraft far-field noise levels at FAA FAR Part 36 (FAR 36) certification conditions (ref. 1). It will also predict near-field and cabin noise levels for turboprop aircraft and static engine component far-field noise levels.

NOISE is a useful computational tool for assessing the impact of GASP aircraft design options upon FAA certification noise levels. Utilization of NOISE will enhance the capability of GASP to systematically perform design trade-off studies, optimizing the aircraft design while minimizing the impact of the resultant noise upon the environment.

NOISE has been developed as a series of modules, each of which performs a specific task within the noise prediction process. The modules are integrated through the use of an executive control module and a data bank containing information to be passed between modules.

Wherever feasible, input data has been initialized to the default values most likely to be required by the user. The major-

ity of data initialization is done in block data subroutines. Extensive documentation has been added within the program, through comment cards, to clarity the calculation procedures and to simplify subsequent modifications.

Input is made through NAMELIST statements, except for title cards. Output options are available and range from a summary of the FAR 36 predicted noise levels to a detailed analysis of static engine noise levels and component flyover predictions at every 0.5-second interval along the flight profile.

NOISE was verified with simulations of twin-engined turbofan and turboprop general aviation aircraft operating at FAR 36 certification conditions. The predicted levels were well within the 5dB tolerance requirement when compared with actual FAA certification noise levels.

All terms are defined in the symbol list, Appendix C.

SECTION II

2.0 NOISE PREDICTION METHODOLOGY OVERVIEW

This section presents an overview of the approach that the user should take to implement the NOISE program for the prediction of FAR 36 certification noise levels. It is important for the user to understand that the approach is divided into two phases. The first phase is external to NOISE and encompasses the engine/aircraft/flight profile definition and the preparation of input data to NOISE. The second phase involves the execution of program NOISE for user-specified conditions. A block diagram of the overall procedure is given in Figure 1.

2.1 Engineering Approach - Phase I

The procedure begins with the definition of the reference engine, on a component basis, and the reference aircraft. Next, the performance flight profile for the appropriate noise prediction condition (approach, full-thrust takeoff or level flyover) must be determined so that the engine/aircraft performance parameters for the acoustic analysis can be defined.

The engine cycle parameters for the takeoff condition are determined based on the aircraft altitude and operating conditions at 6500 meters (21,315 ft) from brake release. A listing of the required engine cycle parameters, on a component basis, can be found in the NAMELIST Tables, Paragraph 6.2. The engine cycle parameters for the approach condition are determined for the aircraft on a 3-degree glide slope at an altitude of 120.1 meters (394 ft) with maximum flaps. The engine cycle parameters used in the sideline prediction are those that correspond to the aircraft altitude at which maximum sideline noise occurs. For a typical gas turbine-powered business aircraft, this altitude is approximately

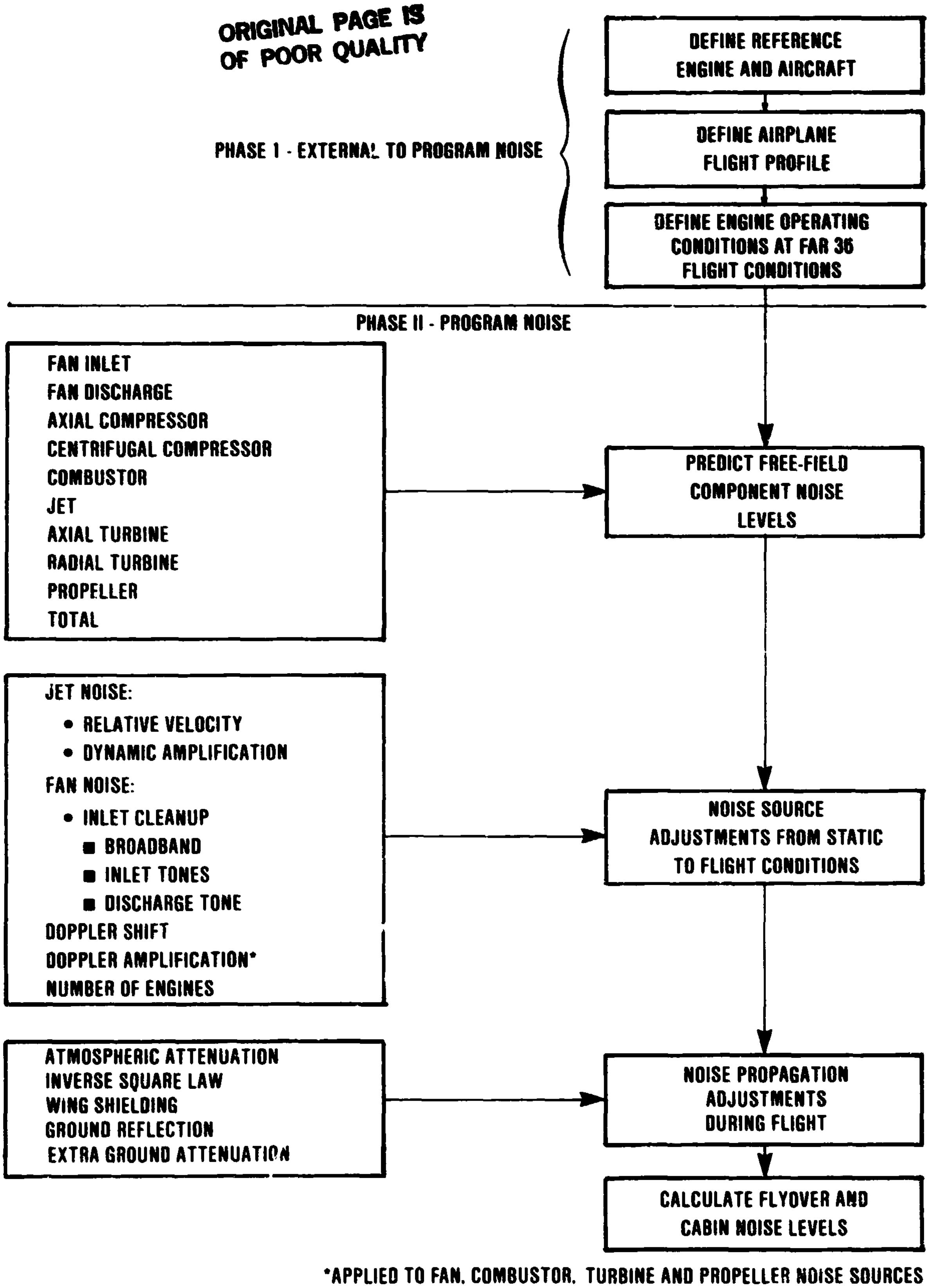

Figure 1. Flyover Noise Prediction Procedure.

300 meters (984 ft). In addition to the engine cycle parameter values, the user must also determine the aircraft velocity, flight angle and angle-of-attack.

The results of these efforts are a definition of the appropriate flight profiles and engine operating conditions at takeoff, sideline, and approach conditions per FAR 36.

An externally generated flight profile is not necessary to determine engine/aircraft performance for level flyovers. Instead, the user should determine the engine/aircraft performance parameters directly for a 304.8-meter (1000-ft) altitude level flyover with the engine operating at the highest power in its normal operating range. The aircraft must operate at a constant speed in its cruise configuration with propellers synchronized. In Phase II, NOISE will generate the level flyover flight profile for these conditions.

The preliminary design intent of program NOISE allows the utilization of a single engine/aircraft operating performance condition in the prediction of flyover noise levels. While some accuracy may be lost because engine and aircraft performance variations are not accounted for throughout the flight path, the resultant prediction accuracy is within the scope of the program and a substantial amount of computing time is saved.

The procedures outlined above for Phase I are external to program NOISE. The user must execute these procedures with engine/aircraft performance and mission analyses programs, such as those found in the GASP system.

2.2 Engineering Approach - Phase II

Phase II involves the execution of program NOISE, utilizing the engine/aircraft parameters determined in Phase I.

After NOISE validates the input data and establishes appropriate default values, where necessary, the PATH module in program NOISE creates a flight profile for noise predictions. This profile is established at 0.5-second intervals throughout the flight path. Two options are available to the user. For the first option, the user can input values defining the aircraft speed and attitude over the microphone measuring location. NOISE will then generate a straight line approximation of the flight profile. For the second option, the user can input the flight profile created in Phase I through a separate computer mass storage logical unit such as a disk or tape file.

When the flight profile has been established, the static free-field noise spectra for individual engine components are predicted in the STATIC module as a function of the engine geometry and cycle parameters. The system has been designed functionally so that the predictions of sound level spectra from each engine component noise source (fan, compressor, combustor, exhaust jet, turbine, and propeller) are performed in separate subroutines. This facilitates the modification of the predictive methodology as technological improvements are made, with a minimum disruption of other functions. Static-to-flight component noise source corrections are made within the STATIC noise prediction module. The output of the STATIC component noise prediction module provides individual component noise levels in 1/3-octave bands for 10-degree increments from 10° to 160° from the engine inlet centerline at a 30.5-meter (100-ft) radius. Details of the individual component noise prediction procedures can be found in Section 3.

The FLYCON module controls the calculations for in-flight aircraft noise levels based on the predicted free-field static noise source spectra corrected to flight conditions. For the FAR 36 takeoff, sideline and approach conditions, the 30.5 meter (100 ft) corrected spectra for each source are "flown" along the acoustic flight profile by executing the FLYOVR module. The slant distance and angle of radiation between the engine centerline and the propagation path to the microphone are calculated each 0.5 second from brake release. The calculation procedure uses two coordinate sets for the computation of distance and angular positions. A fixed set of coordinates is placed at the point of brake release, and moving coordinates are placed on the airplane.

For the takeoff condition, the measurement microphone is defaulted to a location 6500 meters (21,325 ft) from brake release and directly under the flight path. The sideline condition requires an iteration process to determine the measurement microphone location relative to the brake release reference point. The microphone is located on a path parallel to and 450 meters (1476 ft) from the runway centerline. The position of the microphone along the path is defined as the point at which the maximum effective perceived noise level, L_{EPN}, occurs. The approach condition measurement microphone is located underneath the flight path 2291 meters (7516 ft) from touchdown. This corresponds to the FAR 36 microphone location as long as a constant 3-degree glide slope is maintained to touchdown.

For each slant distance and angle of noise radiation, the noise-source spectra are corrected for the following flight and propagation effects:

(a) Spherical divergence (inverse square law)
(b) Atmospheric absorption
(c) Number of engines
(d) Wing shielding (inlet sources only)

(e) Reflecting ground plane

(f) Extra-ground attenuation.

The flight effects of Doppler shift and dynamic amplification of moving sources are calculated within the STATIC module as static-to-flight corrections. The total engine noise spectra are obtained at each 0.5-second interval by adding the individual noise source spectra antilogarithmically.

For each flyover condition, the L_P, L_{PA}, L_{PN}, and L_{TPN} are calculated each 0.5 second for each noise source and for the total aircraft noise until the flyover noise levels at the microphone locations are at least 10-dB below the maximum L_{TPN}. The resultant duration time, duration correction and L_{EPN} are calculated for each noise source and for the total noise in accordance with the calculation procedures contained in Appendix B of FAR 36, except that the 90-dB L_{TPN} limit is optional.

SECTION III

3.0 NOISE MODULE DESCRIPTION

This section provides a brief description of the control logic and engineering methods used within the modules. Top-down programming techniques were utilized throughout the development of the program. Each module was designed independently around its specified task and tested with driver programs utilizing data selected to check all module options. An outline of the executive software system is shown in Figure 2.

NOISE is comprised of six major modules:

- o Executive Control
- o Input
- o Flight Profile Generation
- o Engine Component Static Noise Level Predictions
- o Aircraft Flyover Noise Level Predictions
- o Output.

3.1 Executive Control Module (NOISE)

The main program, NOISE, is the basic control module for aircraft noise predictions; it controls the overall logic and processing for the noise prediction conditions specified by the user. NOISE calls the input module and, subsequently, the static and flyover control modules and the output module, as required.

3.2 Input Module (INDATA)

Subroutine INDATA reads user-input data through NAMELISTS and establishes default values for certain variables, if not input by the user. The following NAMELISTS have been established:

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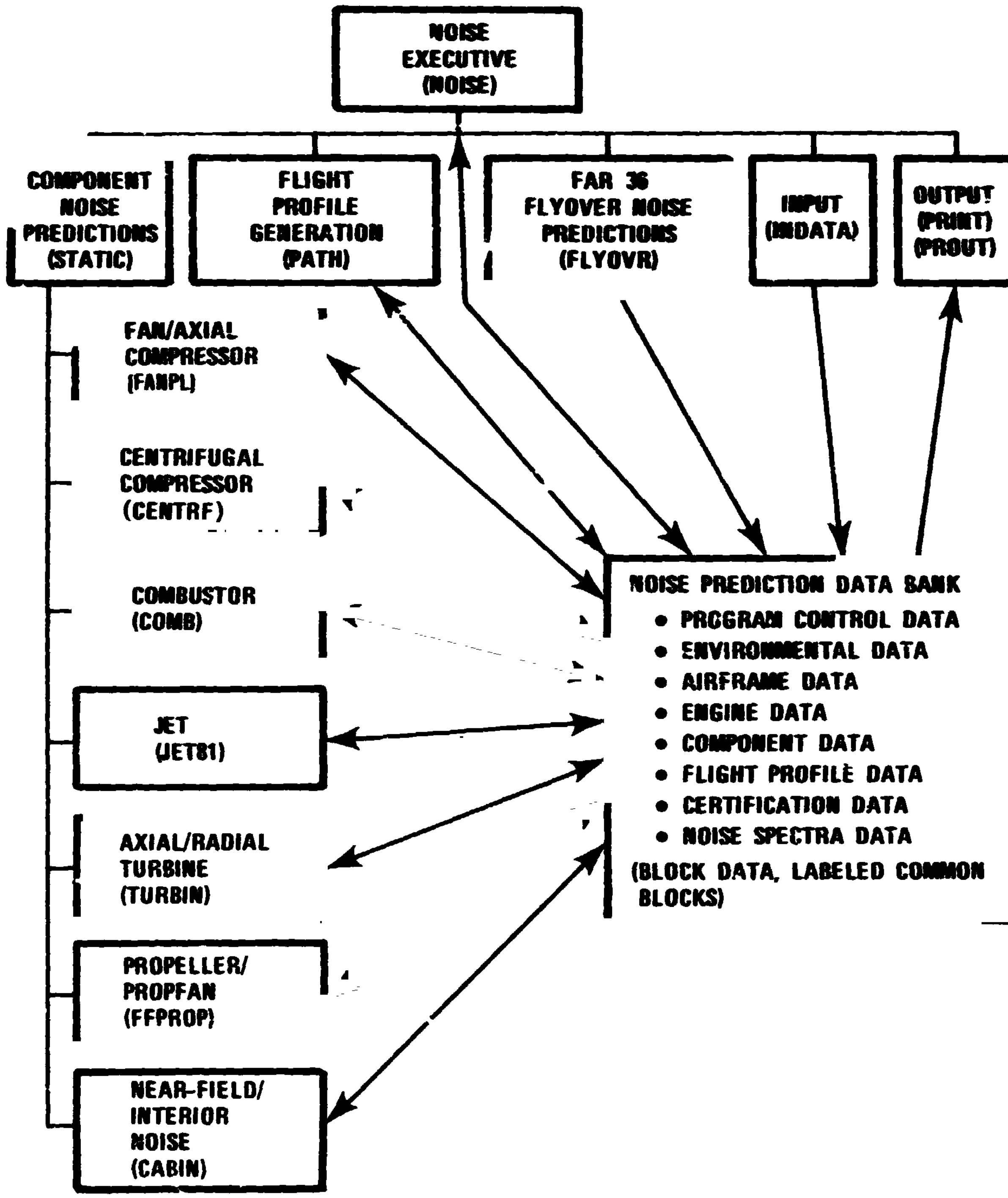

Figure 2. Executive Software System Organization.

- o &CONT - sets the flyover condition and output options
- o &ENV - establishes the ambient conditions and static prediction geometry
- o &SYS - establishes the engine and aircraft description or variables
- o &FPRO - establishes the variables required to generate a flight profile
- o &FAN, &CENT, &BURNER, &JET, &TURB, &PROP - establish the required input variables for use by each of the component prediction modules
- o &FLY - sets iteration limits for determining the maximum sideline L_{EPN} and sets options for FAR 36 calculations
- o &CAB - establishes input variables required for cabin noise predictions

INDATA checks certain critical variables and aborts the program if they are not specified. It also sets the control logic for calling the component modules in the proper order. The majority of data initialization is done in a BLOCK DATA subroutine, so that certain default values can be assumed by the user.

3.3 Acoustic Flight Profile Generation (PATH)

Subroutine PATH generates an approximate straight line profile for the user-specified FAA certification condition, and it assumes a constant aircraft velocity throughout the profile. PATH also contains an option to accept a user-input flight profile on logical unit 55 which must conform to a specified file format. The source code can also be changed by the user so that an existing computer-formated flight profile can be read. The flight profile generated by PATH gives the aircraft position (range and altitude), angle of attack, and climb angle at 0.5-second intervals. If the user-input

profile option is invoked, PATH interpolates it at 0.5-second intervals.

The maximum length of time for any profile is 249.5 seconds. The initial time is established as 0.0 seconds. For the straight-line profile approximation, the user must input either the aircraft velocity or Mach Number or the program will abort.

The takeoff and sideline profiles include a takeoff ground roll from brake release to a point just past aircraft rotation. This distance (TOROLL) is input by the user, or defaults to 1371.6 meters (4500 ft) for fans and jets or to 701.0 meters (2300 ft) for turboprops. After rotation, the aircraft flys at a constant velocity (VEL), flight angle (FLTANG), and angle of attack (ANGAFT).

The time rate of change of aircraft altitude and range, and thus the profile, are determined by:

$$\frac{d(alt)}{dt} = V_0 \sin(\gamma)$$

and

$$\frac{d(range)}{dt} = V_0 \cos(\gamma)$$

where V_0 - is the aircraft velocity

γ - is the aircraft flight angle

alt - is the aircraft altitude

range - is the aircraft range from the rotation location.

The approach condition is defaulted to give a constant 3-degree glide slope path to touchdown. The initial range is computed to just exceed the 1.4-radian (80-degree) half-cone angle centered on the microphone location. The user has the option to modify the glide slope angle and the initial range.

Flight profile geometries are depicted in Figures 3 through 5 for FAR 36 certification conditions. If the user selects the option to input an externally-generated profile on logical unit 55, according to the specified format (see User's Manual for format instructions), and the flight velocity or Mach Number have not previously been input through NAMELISTS, PATH will select the flight velocity to be used for the prediction procedure. For take-off and approach conditions, the velocity is defaulted to that at the aircraft's position over the measuring station [XFAA(1) for approach and XFAA(2) for takeoff]. For the sideline condition, the flight velocity is selected at a default aircraft altitude of 300 meters (984 ft). This corresponds to the average altitude at which the maximum sideline effective perceived noise level occurs for a wide variety of gas turbine-powered aircraft. The user can override the default altitude.

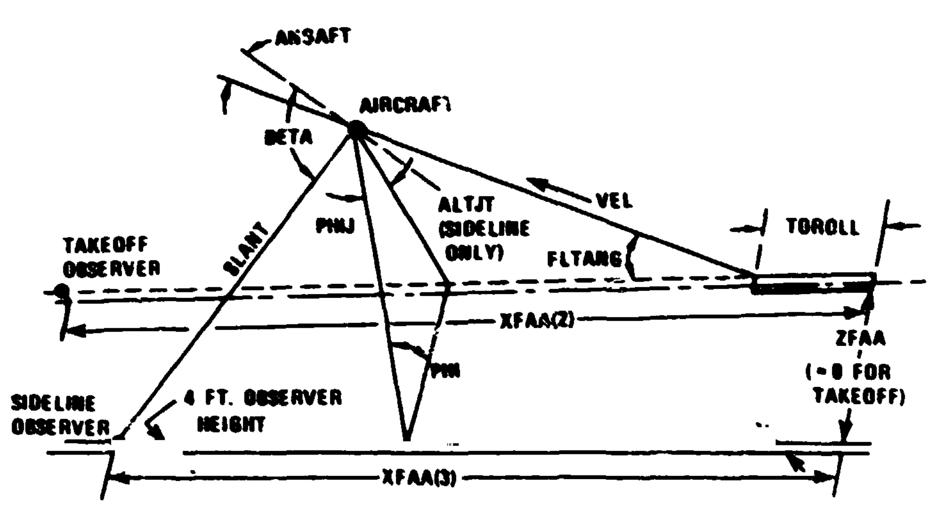

Figure 3. Flight Profile Geometry for Takeoff and Sideline.

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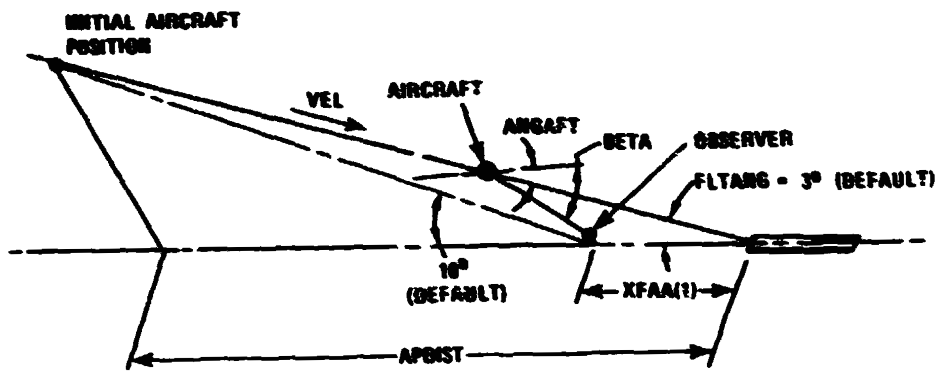

Figure 4. Flight Profile Geometry for Approach.

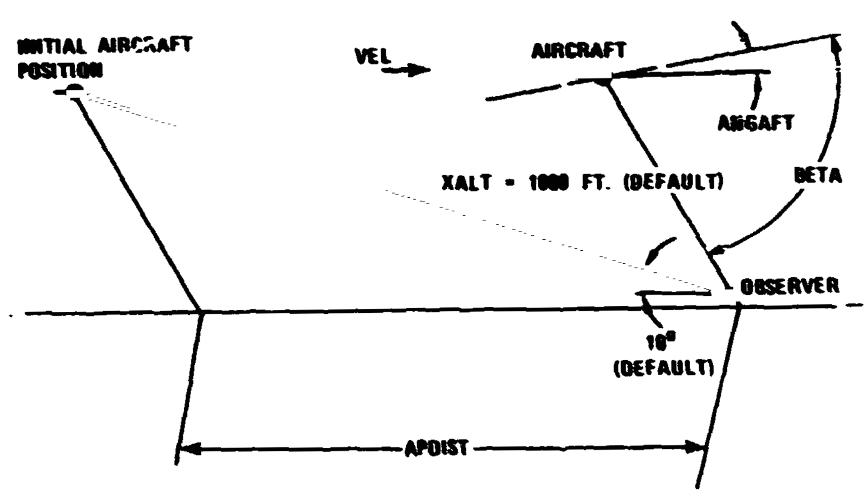

Figure 5. Flight Profile Geometry for Level Flyover.

3.4 Engine Component Static Prediction Procedures

3.4.1 Static Control Module (STATIC)

Subroutine STATIC calls each component noise source module in a user-specified order. Axial fan inlet and discharge noise spectra are computed individually and are treated as separate noise sources through internal program logic. The component static noise spectra are predicted in 1/3-octave bands, over a range of 20 Hz to 20000 Hz. After the spectra for each noise source are returned to STATIC, a Doppler frequency shift is made on the spectra, if required.

A subset of the spectra, covering the frequency range of 50 Hz to 10000 Hz, is produced for use in the flyover module. If the user-specified ambient temperature and relative humidity are not FAA standard day conditions (77°F and 70-percent RH), atmospheric absorption corrections to the FAA standard day are made in conjunction with the creation of the flyover subset spectra. Output of the individual component static spectra includes atmospheric absorption for the user-specified ambient conditions.

Certain static-to-flight corrections, if applicable, are performed within the STATIC module or within the component modules called by STATIC. These corrections are briefly described below:

(a) Doppler Shift - The 1/3-octave frequency spectra are corrected for the shift that occurs in a moving source relative to a fixed observer. This frequency shift is calculated using:

$$f_r = \frac{f_o}{1-M_o\cos\beta}$$

f_r = observed frequency
M_o = aircraft Mach number
f_o = source frequency
β = angle from engine inlet to observer

Subroutine DOPPLE, obtained from NASA-LeRC, is used to calculate the Doppler frequency shifts.

(b) Doppler Amplification (Dynamic Effect) - The change in L_p that occurs due to the motion of a moving source is calculated. The analytical model for noise propagation of a moving source is used as the basis of the calculation. The correction is computed by:

$$\Delta dB = CA \log_{10} \frac{1}{1-M_o \cos\beta}$$

where M_o and β are defined in (a) above, and default values for CA = 40.0 for fan, compressor, and turbine and propeller loading noise; 20.0 for combustor noise; 10.0 for propeller vortex noise.

The dynamic amplification is applied to the fan inlet and discharge noise, combustor noise, turbine noise, and propeller-noise levels. This effect is not applied to the jet noise. The dynamic effect correction on the jet-noise level, along with the relative-velocity effect when the engine forward speed is greater than zero, is described in ref. 2.

(c) Inlet Cleanup for Fan Noise - Fan inlet and discharge broadband and discrete noise levels are adjusted for inflight cleanup effects (ref. 3) as follows:

o Broadband Noise:

For rotor-stator spacing (RSS) $\leq$ 100 percent

$\Delta dB = 0.$

For RSS >100 percent

$$\Delta dB = -5 \log (RSS/300) - 2.39$$

- **Discharge Fan Tone:**

For RSS ≤100 percent

$$\Delta dB = 0.$$

For RSS >100 percent

$$\Delta dB = -10 \log (RSS/300) - 4.78$$

- **Inlet Fan Tones:**

For RSS ≤100 percent (for all harmonics)

$$\Delta dB = \begin{matrix} -3.0 \text{ for } \delta \leq 1.05 \\ -8.6 \text{ for } \delta > 1.05 \end{matrix}$$

For RSS >100 percent

Fundamental tone [with and without inlet guide vanes (IGVs)]:

$$\Delta dB = -10 \log (RSS/300) - 4.78 - \begin{matrix} 3.0 \text{ for } \delta \leq 1.05 \\ 8.6 \text{ for } \delta > 1.05 \end{matrix}$$

First harmonic:

$$\Delta dB = -10 \log (RSS/300) - 4.78 - \begin{matrix} 0.8 \text{ (no IGVs)} \\ 2.5 \text{ (with IGVs)} \end{matrix}$$

Second harmonic:

$$\Delta dB = -10 \log (RSS/300) - 4.78 - \begin{matrix} 0.2 \text{ (no IGVs)} \\ 0.6 \text{ (with IGVs)} \end{matrix}$$

where RSS = Ratio of rotor-stator axial spacing to rotor axial chord projection x 100, percent

$$\delta = \left[\frac{M_T}{1-V/B} \right] \text{, the fundamental tone cutoff factor.}$$

If $\delta \leq 1.05$, the fundamental tone is cutoff and does not propagate to the far field. If $\delta > 1.05$, the fundamental tone is cut on and does propagate.

M_T = Rotor tip Mach No.

V = Number of stator vanes

B = Number of rotor blades

3.4.2 Fan and Axial Compressor Noise Module (FANPL)

The fan and axial compressor noise module (FANPL) is based on the NASA-LeRC prediction procedure described in ref. 3. The computer code corresponding to the ref. 3 procedure was supplied by NASA-LeRC. Noise emitted from fans and axial compressors is composed of discrete and broadband components that radiate from the fan inlet and discharge engine ducts. At supersonic rotor tip speeds, a shock-wave generated combination tone noise also radiates from the fan inlet duct.

FANPL follows the methodology of ref. 3 by predicting separately the spectral shape, peak noise level, and free-field directivity of each contributing noise component. Corrections are also applied for inlet guide vanes, rotor-stator spacing, inlet flow distortion and discrete tone cutoff. A schematic of the FANPL prediction methodology is shown in Figure 6.

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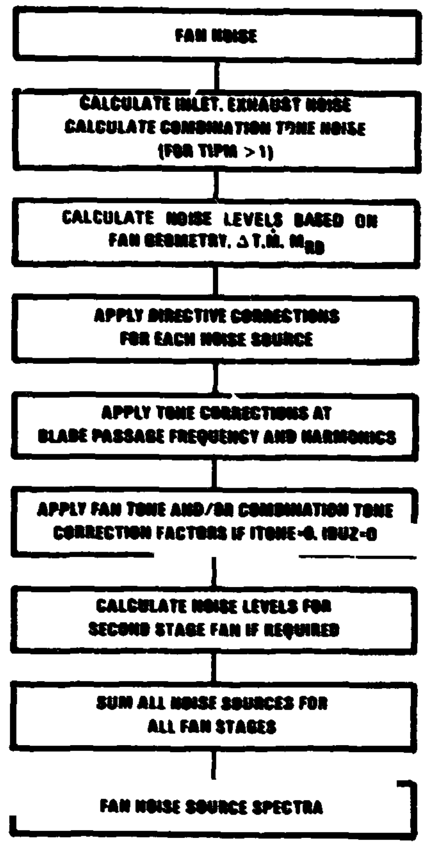


Figure 6. Fan Noise Prediction Methodology.

The ref. 3 noise prediction methodology, summarized herein, is based on correlations with NASA-LeRC large full-scale, single-stage fan test data. When correlations were performed by Garrett with test data from smaller general aviation class turbofan engines, the procedure usually overpredicted fan discrete tone levels at angles of 10 degrees to 40 degrees from the inlet and underpredicted at angles of 80 degrees to 100 degrees. Combination tone noise was found to be substantially overpredicted at all inlet angles. These correlations with general aviation turbofans resulted in revisions to the ref. 3 procedure for fan inlet and discharge discrete tone directivities and for combination tone levels and directivity.

The fan and compressor inlet and discharge discrete and broadband noise contributions are calculated from the basic equation formulated in ref. 3:

$$L_C = 20 \log_{10} (\Delta T/\Delta T_o) + 10 \log_{10} (\dot{m}/\dot{m}_o)$$

$$+ F_1 \left[(M_{TR}), (M_{TR})_D \right] + F_2 \text{ (RSS)} + F_3 (\theta)$$

where: L_C = One-third octave band characteristic partial sound pressure level (broadband or discrete tone contribution), of a single-stage fan at 1-m radius, dB

ΔT = Total temperature rise across fan, °R

ΔT_o = Reference value of T, 1°R

$\dot{m}$ = Mass flow rate through fan, lb/sec

$\dot{m}_o$ = Reference value of $\dot{m}$, 1 lb/sec

M_{TR} = Rotor tip relative Mach number

$(M_{TR})_D$ = Design point value of M_{TR}

RSS = Rotor-stator spacing in percent at rotor tip

θ = Directivity or polar angle relative to inlet axis, degrees

The function F_1 is determined from the appropriate curves in ref. 3 for inlet or discharge discrete or broadband noise. F_2 is determined as a function of rotor-stator spacing with or without the effect of inlet distortion depending on static or flight mode. F_3 is determined from the appropriate directivity curve for each noise contribution. The sound pressure level for each contribution is calculated from L_C given above, with a spectrum shape function determined as a log normal distribution centered about 2.5 times

the blade passage frequency for broadband noise, and as a series of discrete tone multiples of the blade passage frequency, accounting for cutoff and inflow distortion effects. The function F_3 is optionally revised for general aviation class fans as shown in Figures 7 and 8.

A combination tone noise component is also included for first-stage fans when the rotor tip speed is supersonic. Its peak level is computed for center frequencies at 1/2, 1/4, and 1/8 of the fundamental blade passage frequency, and is given by

$$L_C = 20 \log_{10} (\Delta T/\Delta T_o) + 10 \log_{10}(\dot{m}/\dot{m}_o) + F_1' (M_{TR})$$

$$+ F_2' (\theta) + F_3' (f/f_{BP}, M_{TR}) + C$$

where: f = 1/2, 1/4, or 1/8 of the fundamental blade passage frequency

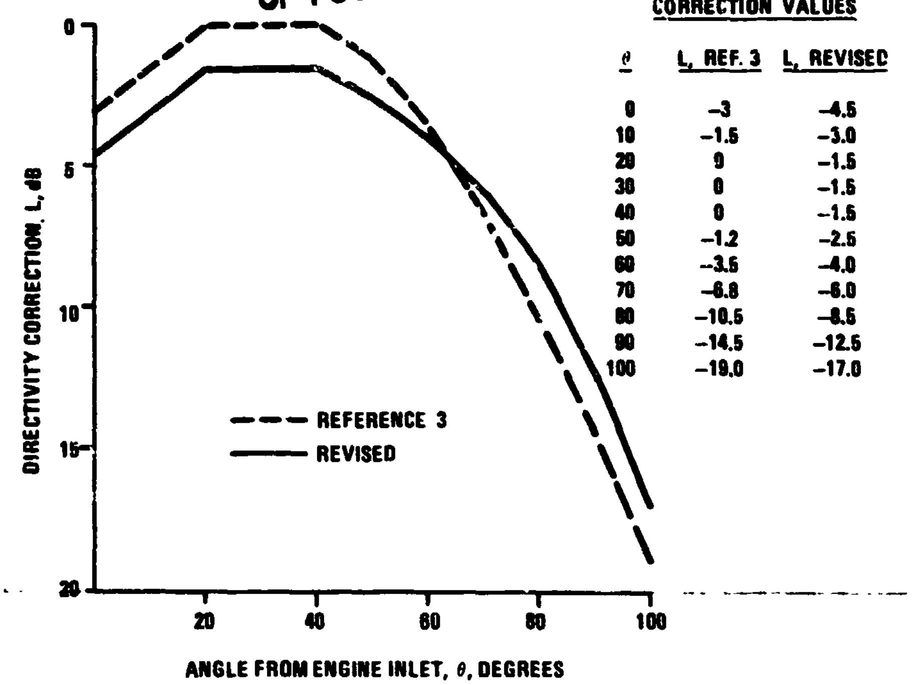
f_{bp} = Fundamental blade passage frequency

C = Constant

and F_1', F_2', and F_3' are functions of curves presented in ref. 3. F_2' and F_3' are optionally revised for general aviation class engines as shown in Figures 9 and 10.

The inlet discrete, broadband, and combination tone spectra, and the discharge discrete and broadband spectra are combined on an energy basis at each polar angle to form the total fan and axial compressor free-field sound pressure levels.

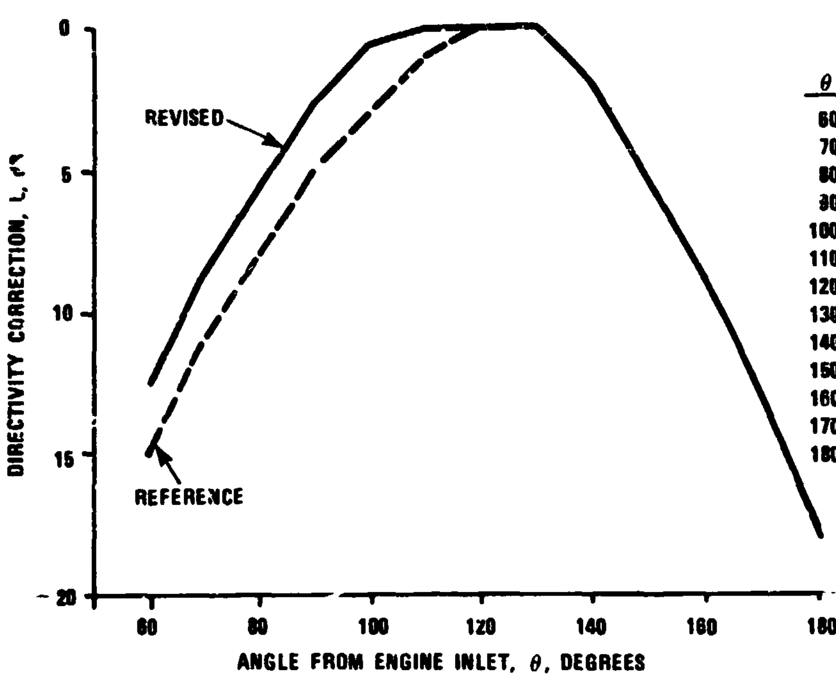
Fan noise module validation studies were made in two steps. First, comparisons were made between predicted and measured data from NASA Fan A, Fan B, and Fan QF-1. The fan module predictions, with no correction factors applied, were consistently about 3dB



CORRECTION VALUES

θ	L, REF. 3	L, REVISED
0	-3	-4.5
10	-1.5	-3.0
20	0	-1.5
30	0	-1.5
40	0	-1.5
50	-1.2	-2.5
60	-3.5	-4.0
70	-6.8	-6.0
80	-10.5	-8.5
90	-14.5	-12.5
100	-19.0	-17.0

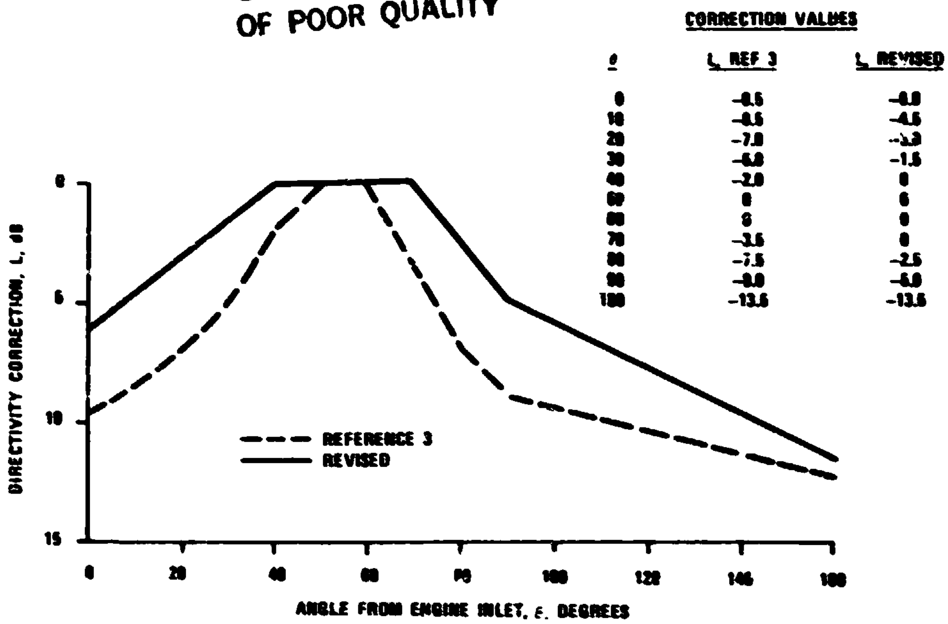
Figure 7. Discrete Tone Directivity Correction, Fan Duct Inlet.



CORRECTION VALUES

θ	L, REF 3	L, REVISED
60	-15.0	-12.5
70	-11.0	-8.5
80	-8.0	-5.5
90	-5.0	-2.5
100	-3.0	-0.5
110	-1.0	0
120	0	0
130	0	0
140	-2.0	-2.0
150	-5.5	-5.5
160	-9.0	-9.0
170	-13.0	-13.0
180	-18.0	-18.0

Figure 8. Discrete Tone Directivity Correction, Fan Discharge Duct.



θ	L_θ REF 3	L_θ REVISED
0	-9.5	-6.0
10	-8.5	-4.5
20	-7.0	-3.0
30	-5.0	-1.5
40	-2.0	0
50	0	0
60	0	0
70	-3.5	0
80	-7.5	-2.5
90	-9.0	-5.0
180	-13.5	-13.5

Figure 9. Directivity Correction for Combination Tone Noise.

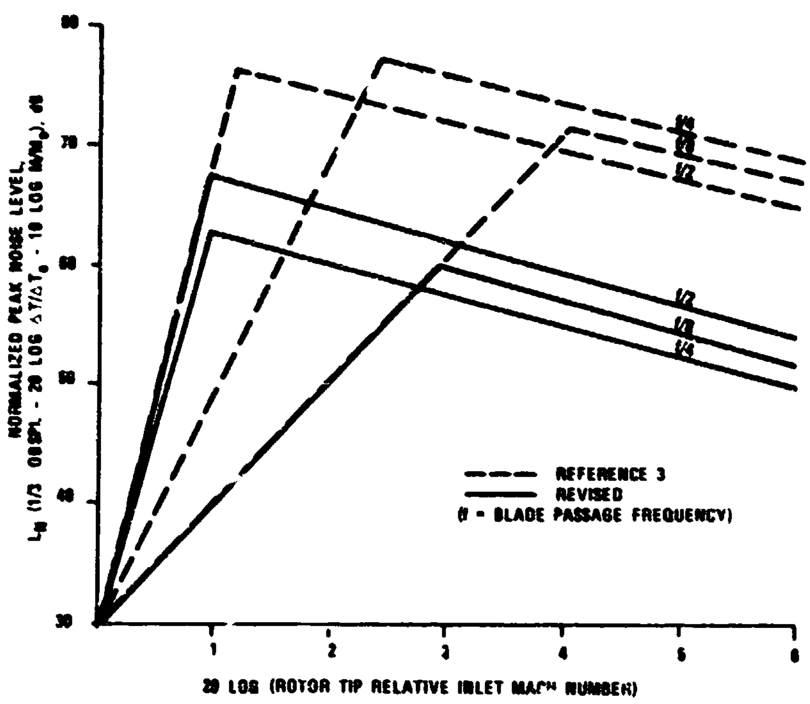


Figure 10. Combination Tone Noise Levels at 1/2, 1/4, and 1/8 of Blade Passage Frequency.

below the predictions reported in ref. 3. The NASA-supplied listing and Garrett codes were carefully compared, and no differences were found. The second step of the validation consisted of a comparison between predicted and measured engine data for several general aviation class turbofan engines, including the Garrett TFE731, ATF3, and QCGAT, and the Pratt & Whitney JT15D. Engine acoustic test data was utilized because acoustic test data for isolated fan components was not available. Similarly, engine test data was used to evaluate the remaining engine component noise prediction procedures found in succeeding sections of this report. The prediction method of ref. 3 was found to consistently overpredict the measured noise levels of the smaller, general aviation class fans. The most pronounced differences between measured and predicted levels occur in the fan inlet quadrant at takeoff static conditions where combination tones are major contributor to the total fan inlet noise level.

Significant differences in discrete tone levels were also found to exist at small inlet angles and at angles of 100 degrees and 110 degrees for some engines at takeoff static thrust. Typical examples of the initial prediction comparisons on a total engine noise basis are shown in Figure 11. The fan noise contribution dominates the higher frequency range of the data. Therefore, comparative evaluations of fan noise predictions should be restricted to frequencies above 1000 Hz.

This analysis led to a revision of the fan directivity indices for the predicted discrete and combination tone levels. Comparisons between the original and revised directivity corrections are presented in Figures 7 through 9.

The overprediction of combination tone levels of all available data at all inlet angles led to a revision of the procedure that predicts the peak combination tone levels based on fan blade tip relative Mach number. A comparison of the revised and original

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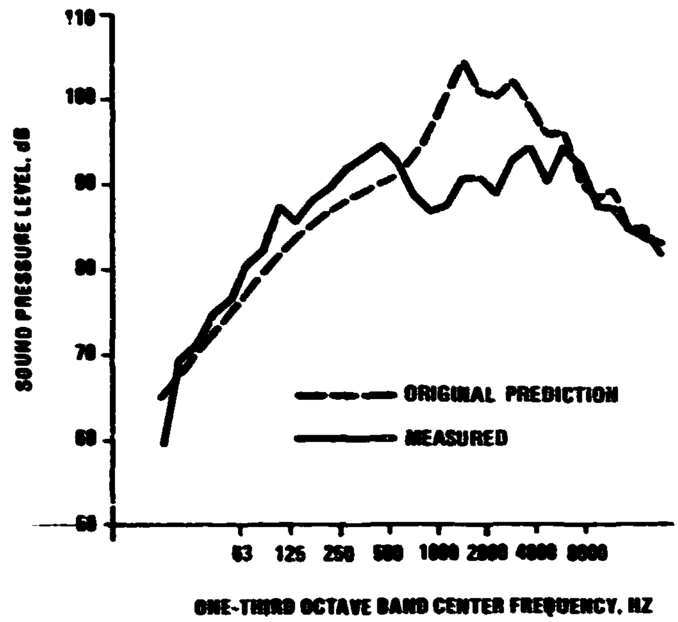

Figure 11(a). Typical TFE731 Engine Noise Spectrum, Measured Versus Original Prediction 60 Degrees Takeoff Static Thrust.

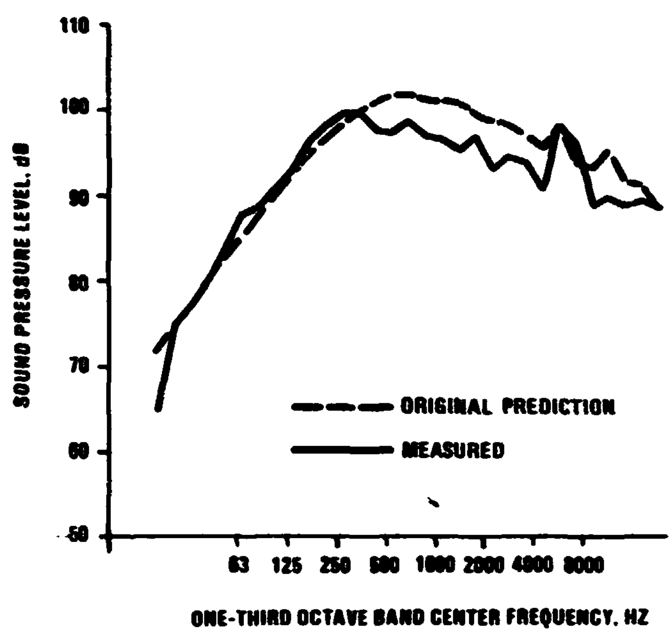

Figure 11(b). Typical TFE731 Engine Noise Spectrum, Measured Versus Original Prediction 120 Degrees Takeoff Static Thrust.

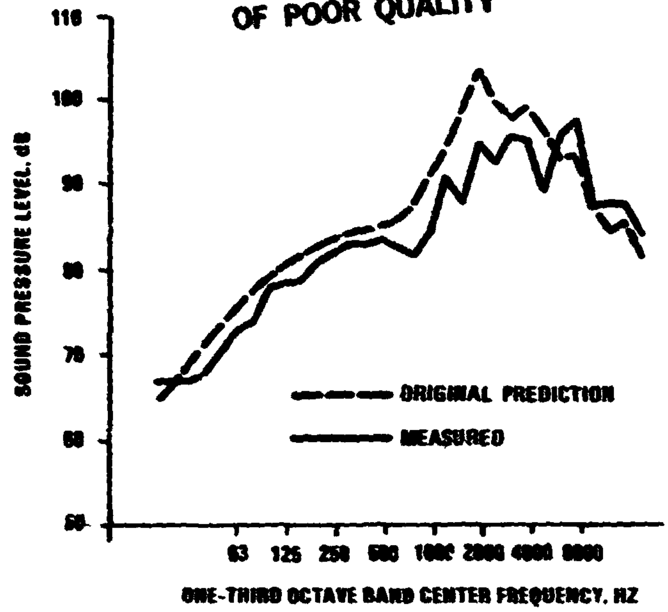

Figure 11(c). Typical JT15D Engine Noise Spectrum, Measured Versus Original Prediction 60 Degrees Takeoff Static Thrust.

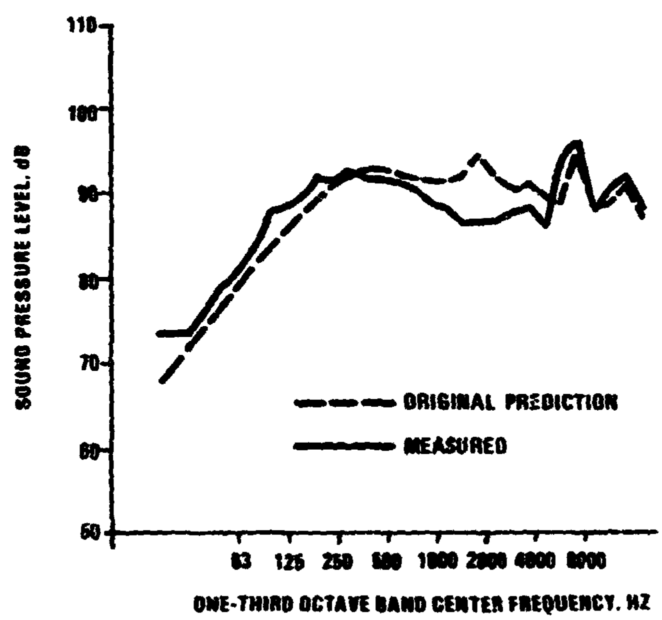

Figure 11(d). Typical JT15D Engine Noise Spectrum, Measured Versus Original Prediction 120 Degrees Takeoff Static Thrust.

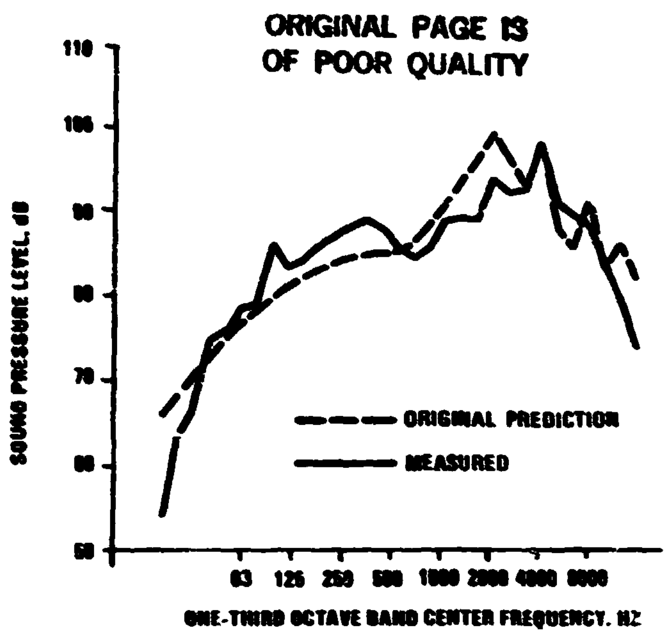

Figure 11(e). Typical QCGAT Engine Noise Spectrum, Measured Versus Original Prediction 60 Degrees Takeoff Static Thrust.

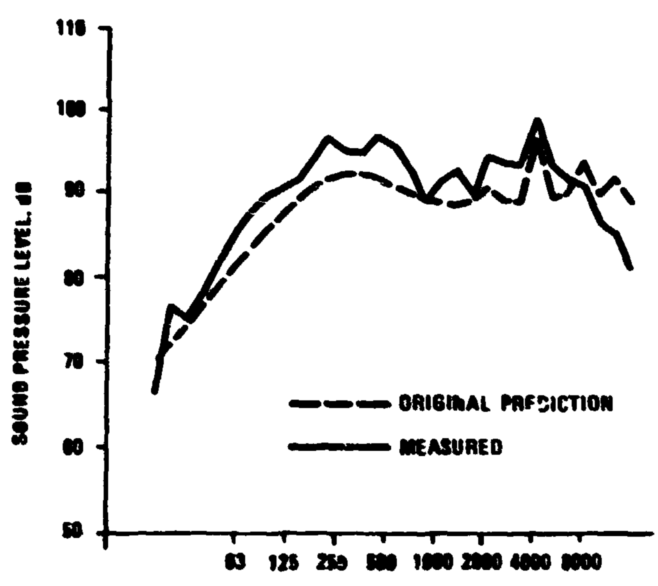

Figure 11(f). Typical QCGAT Engine Noise Spectrum, Measured Versus Original Prediction 120 Degrees Takeoff Static Thrust.

procedures for combination tones is shown in Figure 10. The revised combination tone procedure was developed by correlating the tone levels and rotor relative tip Mach numbers of the test data. A best fit was applied to the correlated data while maintaining the parameters and philosophy of the original procedure. As a result, combination tones at the takeoff static thrust condition are slightly overpredicted for QCGAT, TFE731 and ATF3 engines and somewhat underpredicted for the JT15D engine. Although the combination tone characteristics and relative levels vary with engine models, the revised procedure improved the combination tone predictions for most available test data.

The resulting revised fan noise prediction procedure has improved the accuracy of fan noise predictions for general aviation class turbofan engines when compared with the available test data. Because each engine model in this class exhibits unique engine noise characteristics, the revised procedure was designed to provide the best overall prediction for all engines for which test data was available. It does not necessarily predict the true noise spectra of any individual fan within the data base. Figure 12 presents typical comparisons of the revised procedure with measured static engine test data.

The directivity corrections for predicted discrete tone levels were not changed at angles beyond 110 degrees, as shown in Figure 8. Thus, there are no significant differences between the original and revised prediction procedures at these angles, unless the combination tone levels are high enough to make a meaningful contribution to the overall predicted engine spectra. This can be demonstrated by evaluating the original and revised predicted spectra at 120 degrees, Figures 11 and 12, (b), (d), and (f). The original procedure predicted high combination tone levels for the JT15D, Figure 11(d). The revised procedure eliminated the effect of the combination tones, Figure 12(d), and improved the prediction

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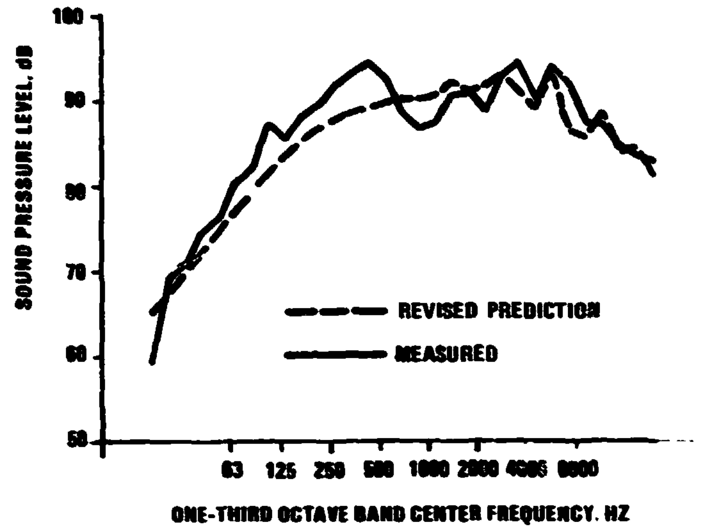

Figure 12(a). Typical TFE731 Engine Noise Spectrum, Measured Versus Revised Prediction 60 Degrees Takeoff Static Thrust.

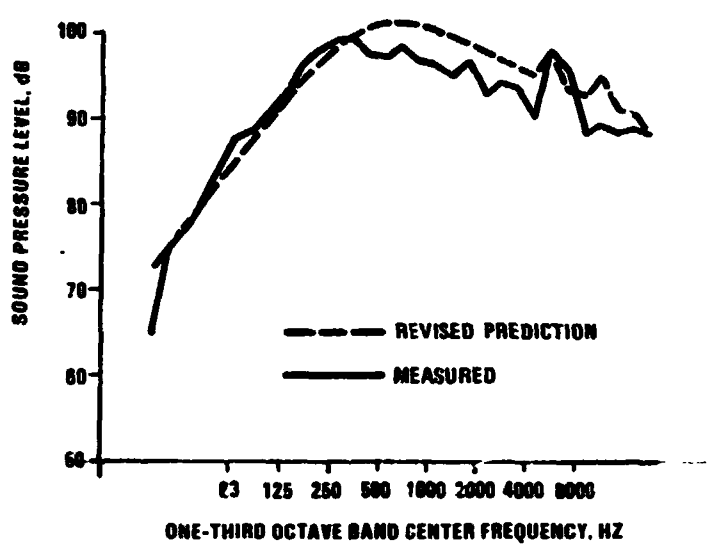

Figure 12(b). Typical TFE731 Engine Noise Spectrum, Measured Versus Revised Prediction 120 Degrees Takeoff Static Thrust.

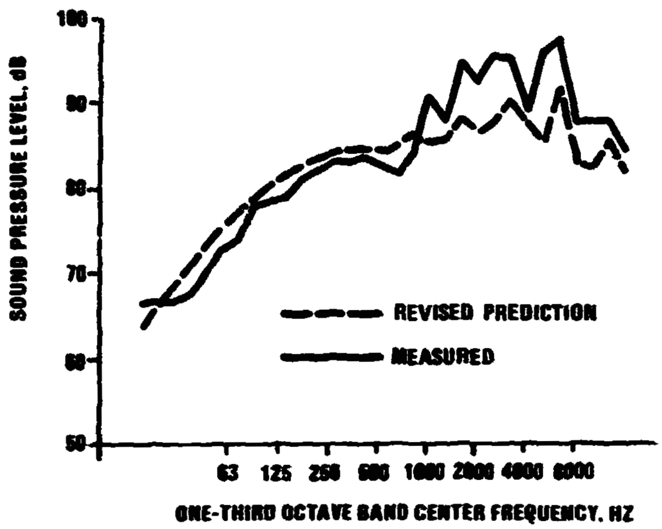

Figure 12(c). Typical JT15D Engine Noise Spectrum, Measured Versus Revised Prediction 60 Degrees Takeoff Static Thrust.

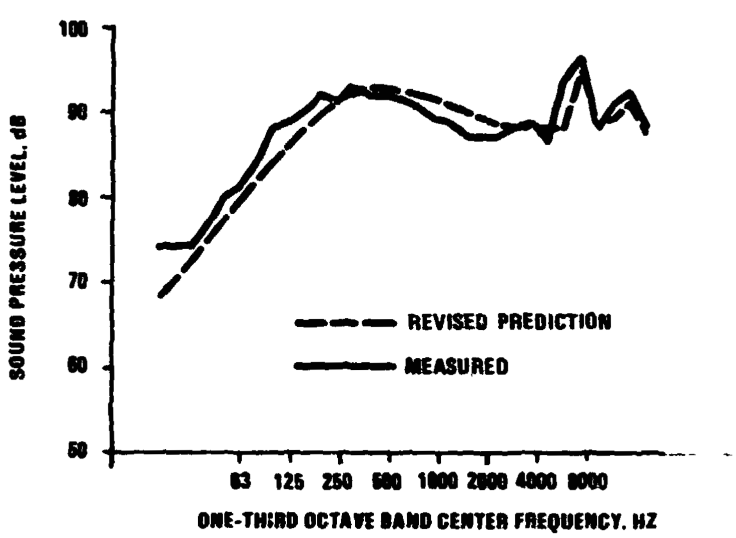

Figure 12(d). Typical JT15D Engine Noise Spectrum, Measured Versus Revised Prediction 120 Degrees Takeoff Static Thrust.

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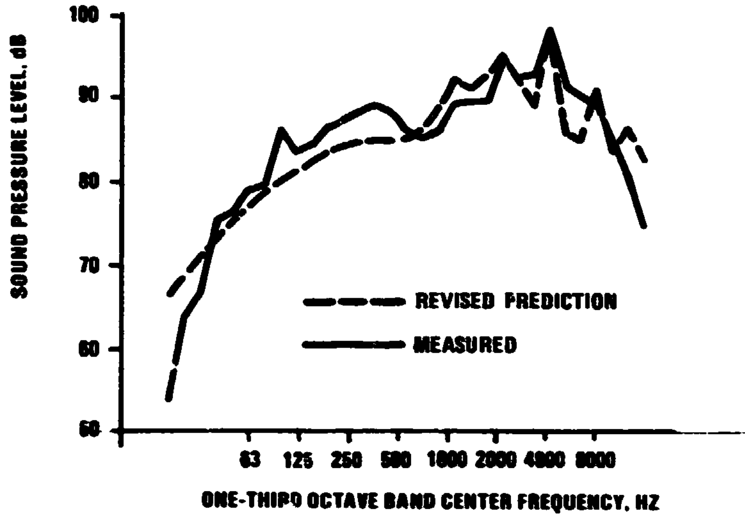

Figure 12(e). Typical QCGAT Engine Noise Spectrum, Measured Versus Revised Prediction 60 Degrees Takeoff Static Thrust.

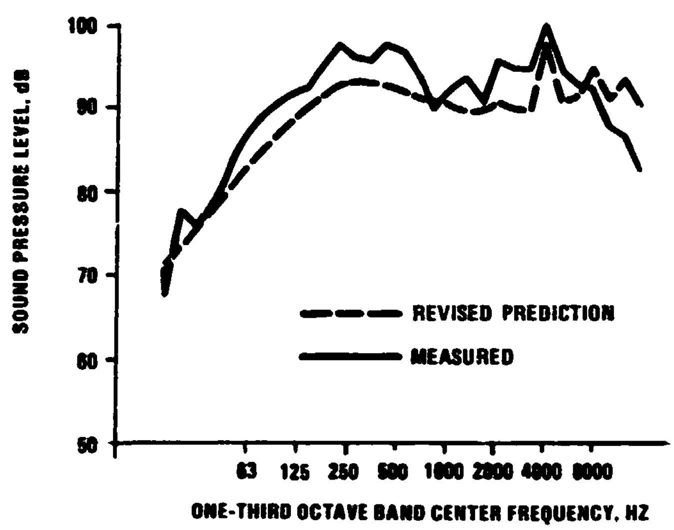

Figure 12(f). Typical QCGAT Engine Noise Spectrum, Measured Versus Revised Prediction 120 Degrees Takeoff Static Thrust.

when compared with the measured spectrum. On the other hand, combination tones do not contribute significantly to the original predicted spectrum at 120 degrees for the TFE731 and the QCGAT engines, Figures 11(b) and (f). Thus, the revised procedure predicts essentially the same spectra at 120 degrees, Figures 12(b) and (f), as does the original procedure.

Differences in the discrete tone levels between test data and the revised prediction procedure still exist; however, in the majority of cases, they have been improved when compared with the original procedure of ref. 3. Discrete tone revisions were limited to adjustments in the directivity correction curves. A more detailed analysis of the discrete tone characteristics, including the parameters that contribute to the peak fundamental tone level and the relative rolloff of its harmonics, should provide further improvements to the fan prediction procedure. Similarly, further improvements in the combination tone model could be achieved through additional analysis and an expanded data base.

Program NOISE provides the user with the options of invoking either the revised (default) or original procedures for discrete and combination tone level predictions. Because the original and revised procedures have been correlated only with single-stage fan data, caution should be used when making two-stage fan predictions. No provision has been made for blade row attenuation between stages.

3.4.3 Centrifugal Compressor Noise Module (CENTRF)

The centrifugal compressor is used extensively in small gas turbine engines, primarily for general aviation turboprops, turbofans, and auxiliary power units (APU). For turbofans, the centrifugal compressor is used in the engine core, and the high-frequency noise generated by the high-speed compressor is significantly attenuated as it propagates upstream through the fan. For turboprops, the centrifugal compressor noise levels tend to be significantly below the propeller noise levels at takeoff and level flyover conditions. At approach condition, the centrifugal compressor can make a measurable contribution to the total flyover noise levels. In the CENTRF module, centrifugal compressor noise levels are calculated in accordance with the methodology described schematically in Figure 13.

The semi-empirical prediction procedure is based on a series of Garrett acoustic tests performed on turboprop and APU compressor rigs and engines. Linear regression analyses of compressor rig test data was used to correlate normalized overall sound power level, L_W, with impeller tip incidence angle. The results, as independently derived for an APU compressor in Figure 14, agree well with the axial fan broadband results of Ginder and Newby (ref. 5).

In order to facilitate noise predictions without requiring the knowledge of impeller incidence angle, a revised correlation based on the deviation from design flow angle was developed. The deviation from design flow angle is calculated in the program based on the user-supplied design point values for mass flow and rpm. The normalized overall sound power level correlates well with deviation flow angle as shown in Figure 15. Each individual turboprop compressor correlates with the deviation from design incidence angle, and the combined data yields a correlation coefficient of 0.874.

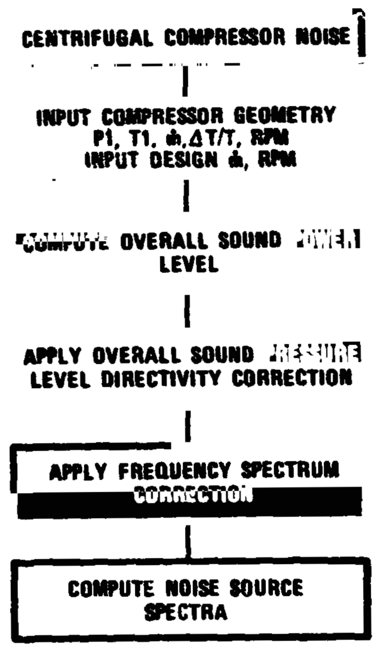

Figure 13. Centrifugal Compressor Noise Prediction Methodology.

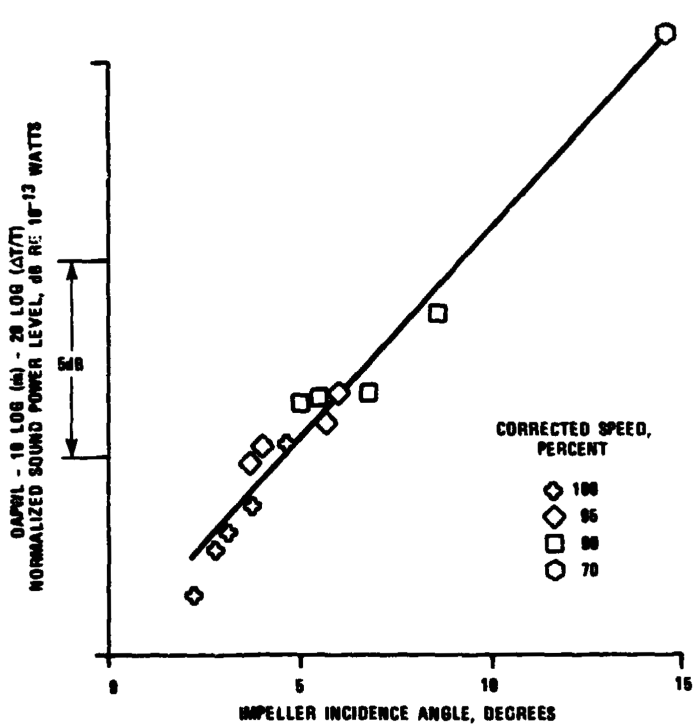

Figure 14. Centrifugal Compressor Sound Power Level Least Squares Regression Analysis.

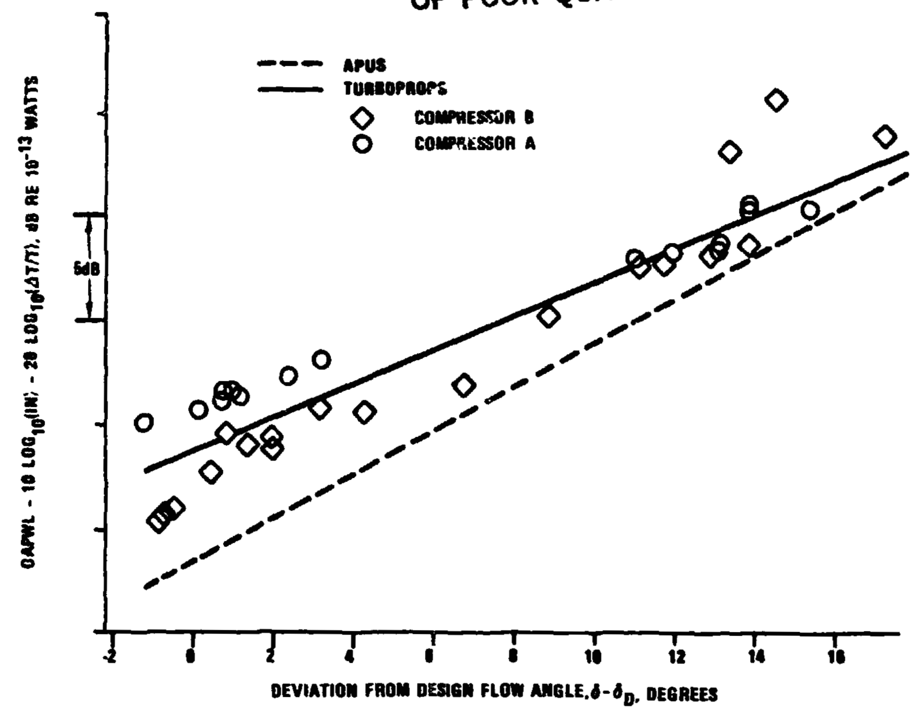

Figure 15. Centrifugal Compressor Overall Sound Power Level Least Squares Regression Analysis.

The basis for the centrifugal compressor noise module is the calculation of overall sound power level from the equation below:

$$L_W = 138.68 + 10 \log_{10} (\dot{m}_1) + 20 \log_{10}(\Delta T/T) + 0.808 \ (\delta-\delta_D)$$

where

L_W = overall sound power level, dB re 10^{-13} watts

$\dot{m}_1$ = compressor mass flow, lb/sec

$\Delta T/T$ = compressor total temperature rise ratio, °R/°R

$\delta-\delta_D$ = deviation from design flow angle, degrees

The overall sound pressure level is determined for each angle from the engine inlet centerline by applying a directivity correction, DI, as follows:

$$L_{P_{oa}}(\theta) = L_{\psi} + DI(\theta) - 20 \log_{10}(R) - 10.5$$

where

$L_{P_{oa}}$ = overall sound pressure level, dB

DI = directivity correction factor

R = far-field distance from engine to observer, ft.

θ = angle from inlet centerline, degrees

The directivity correction is obtained from analysis of various engine data as shown in Figure 16. The true centrifugal compressor directivity is difficult to determ... from most available

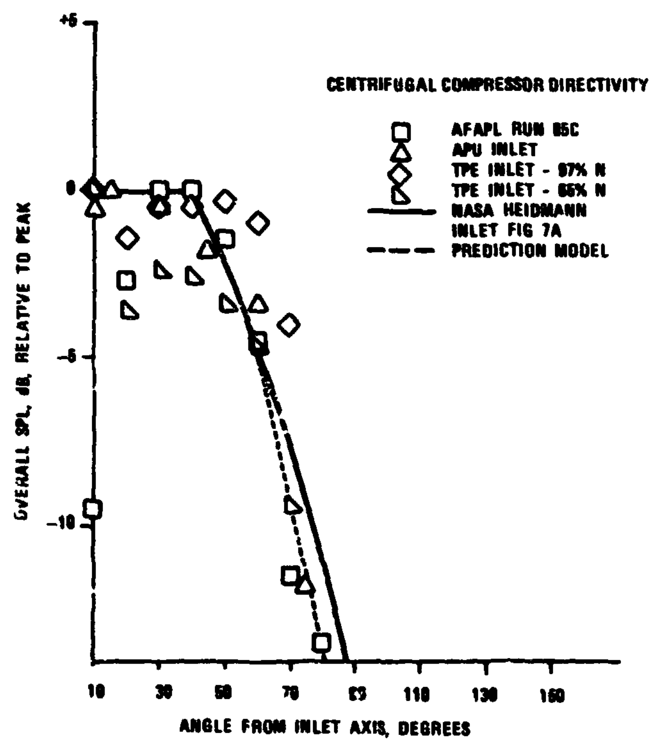

Figure 16. Centrifugal Compressor Directivity.

far-field ground static turboprop data because the propeller noise contributions become significant. The AFAPL data (ref. 6) does not contain propeller noise; however, the compressor noise radiated near the inlet axis was shielded by the dynamometer used in the test Additional centrifugal compressor directivity data was obtained from APU inlet far-field tests where the inlet noise is directed through a straight duct. Note the APU directivity data agrees quite well with Heidmann's result (ref. 3) for fan inlet broadband noise. The final directivity model selected, shown in Figure 16, agrees with Heidmann's curve up to 60 degrees, then decreases more rapidly to better represent the measured data.

The sound pressure level spectra are determined by applying a spectral shape correction, SI, for each frequency. The spectral shape is expressed in terms of the compressor blade passage frequency, f_{bp}, given by

$$f_{bp} = B \times RPMC/60$$

where

f_{bp} = compressor blade passage frequency, Hz

B = number of compressor blades

$RPMC$ = compressor physical speed, RPM

The spectral shape is applied for each 1/3-octave band frequency as follows:

$$L_p\ (\theta, f) = L_{P_{oa}}(\theta) - SI(f) - 0.001\ R \times ATM - CAECDB$$

where:

L_p = sound pressure level, dB

SI(f) = frequency correction array, dB

ATM = atmospheric absorption correction, dB per 304.8 meters (1000 ft)

CAECDB = Doppler dynamic amplification factor

f = frequency, Hz

The Doppler dynamic amplification factor is given by

$$CAECDB = CAEC \log [1. - M_o \times \cos(\theta)]$$

where

CAEC = amplification constant, generally = 40.0

M_o = aircraft flight Mach number

The spectral shape is determined from analysis of turboprop compressor rig and static engine data, as typically shown in Figure 17. The spectral shape of the static engine data contains large contributions from propeller higher harmonics and broadband noise due to inflow turbulence. The identical compressor operating in the rig exhibits a much more pronounced blade passage frequency peak. The selected spectral shape fits the engine data at high frequencies and gradually tails off at the lower frequencies to be more representative of the compressor rig data. Initial attempts to separate the discrete and broadband noise contributions were unsuccessful due to the complex variation of spectral shape over the compressor operating range. The compressor noise spectra

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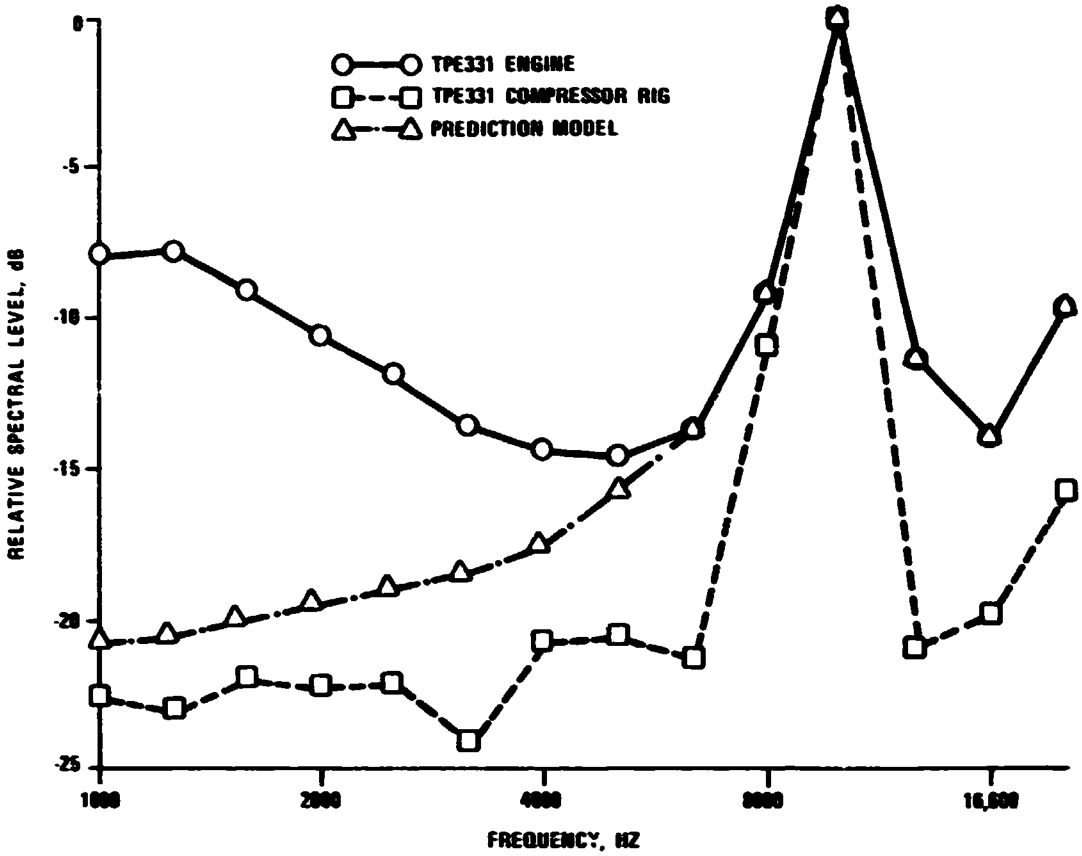

Figure 17. Typical Centrifugal Compressor Noise Frequency Spectrum, 97-Percent RPM.

exhibits two distinct shapes that relate to cutoff of the rotor-only field of the impeller. Below cutoff, the blade passage frequency generally is not dominant in the spectrum. Above cutoff, the compressor blade passage frequency is highly dominant as evidenced by the cut-on spectra shown in Figure 17. A single-shaft turboprop engine generally will operate with the compressor blade passage tone cut-on for the FAR 36 approach, takeoff, and sideline flight conditions; hence, the prediction procedure considers only cut-on spectral shapes.

The centrifugal compressor noise module was substantiated by comparing predicted and measured turboprop static noise data. A typical comparison is shown in Figure 18. In order to determine

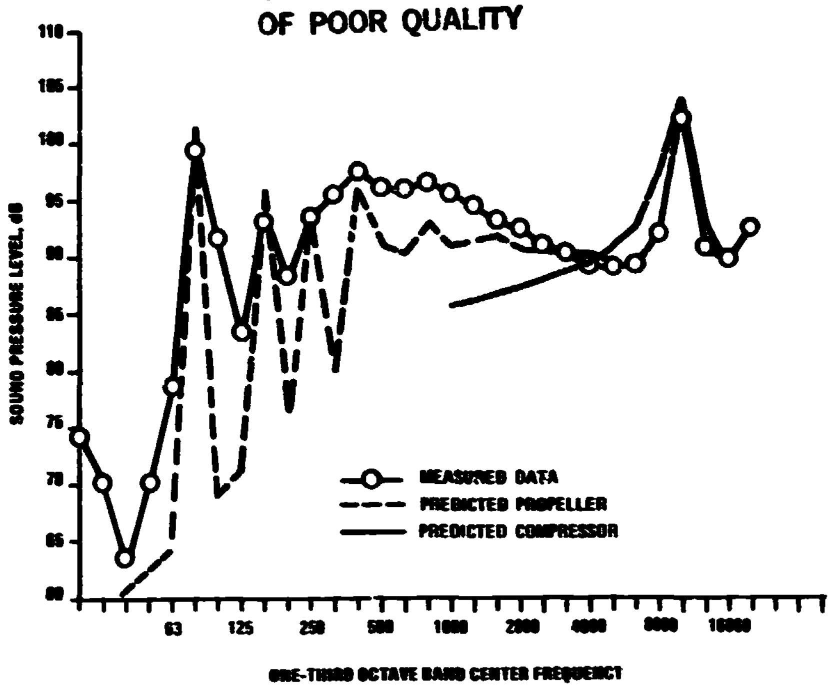

Figure 18. Centrifugal Compressor Noise Data Comparison.

the actual centrifugal compressor noise contributions to the total engine data, propeller noise was estimated using an in-house detailed propeller prediction program. The propeller noise contribution dominates at frequencies up to 800 Hz. The predicted compressor noise agrees well at the blade passage frequency, and the spectral shape of the compressor noise agrees satisfactorily with the measured data.

The centrifugal compressor prediction model is based on engine configurations where no line-of-sight blockage exists between the compressor and the far-field. Thus, caution should be used when making centrifugal compressor noise prediction for turbofan or turboprop applications where the compressor is located downstream of either a fan or axial compressor stage or a tortuous inlet flow path. No provision has been made for upstream blade row attenuation or propagation through curved ducts. It is recommended that centrifugal compressor noise calculations be omitted for these cases.

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3.4.4 Combustor Noise Module (COMB)

The following prediction procedure uses equation (9) from ref. 7, to predict combustion noise. Combustor steady-state parameters are used to calculate combustion noise for existing conventionally designed gas turbine engines according to the methodology outlined in Figure 19.

The procedure begins with the computation of overall sound power level, L_W, dB re 10^{-13} watts. The equation is given as

$$L_W = 56.5 + 10 \log \left\{ \dot{m}_3 \left[(T_4 - T_3) \frac{P_3}{P_o} \frac{T_o}{T_3} \right]^2 \right\}$$

The peak frequency is then calculated, based on engine type. Turbofan peak frequency is computed from the following equation:

$$f_{peak} = 740 \sqrt{\frac{1}{\dot{m}_3} \frac{P_3}{2116.} \sqrt{\frac{518.7}{T4}}}$$

with limits of 355 Hz and 1000 Hz. If the computed values are outside the frequency limits, the peak frequency is set to 400 Hz. Turboshaft engine core noise peak frequency is not computed, but set to 400 Hz. The spectrum is computed from a normalized spectrum shape derived from ref. 8 and shown in Figure 20.

The spectrum shape factor is applied to the overall sound pressure level at each 10-degree angle for the specified input distance. The computed overall sound pressure level includes dynamic amplification. The 1/3-octave sound pressure level spectra is given by

$$Lp(\theta,f,R) = L_W - 20 \log (R/3.28) + DI(\theta) + FSNX_f$$

$$-CAEC \log_{10} (1-M_o \cos \theta)$$

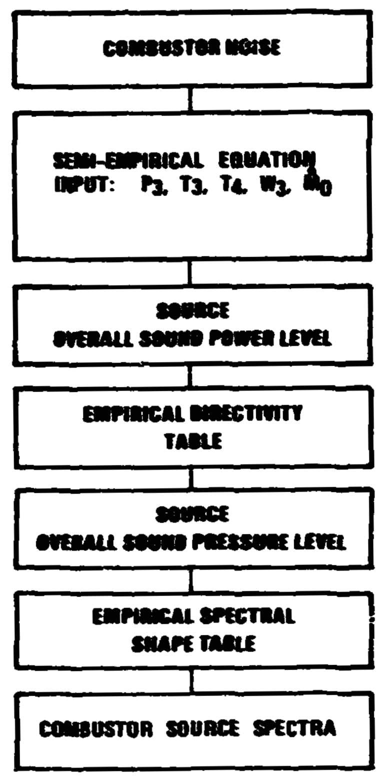

Figure 19. Core Noise Prediction Methodology.

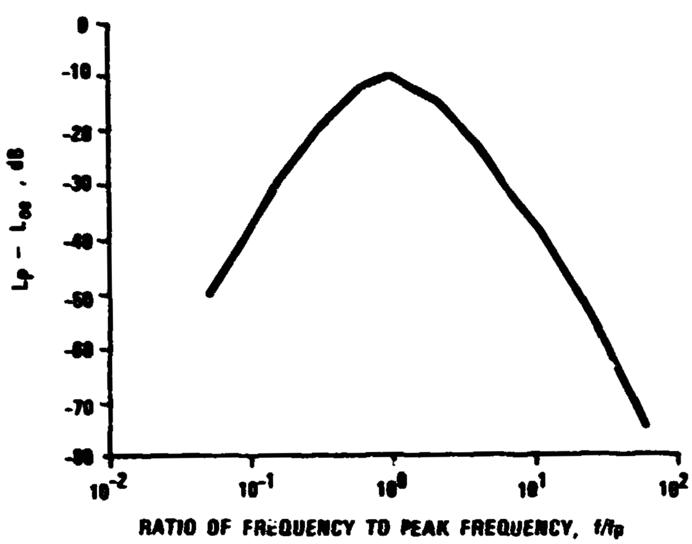

Figure 20. Normalized Combustion Noise Frequency Spectrum.

where

$FSNX_f$ = (f/f_{peak}), spectrum shape factor, Figure 20

$DI(\theta)$ = $(L_P-L_W)_\theta$, directivity, Figure 21

CAEC = Dynamic amplification, user defined, default value = 20.0

The directivity functions used in this program are shown in Figure 21 as a function of engine type. Turbofan directivity was taken from ref. 7, Figure 13. Turboshaft directivity uses the values of ref. 7 for angles of 10 degrees through 130 degrees. Beyond 130 degrees, the directivity from ref. 8 is used and reformated to be compatible with the ref. 7 directivity definition, $(L_P-L_W)_\theta$.

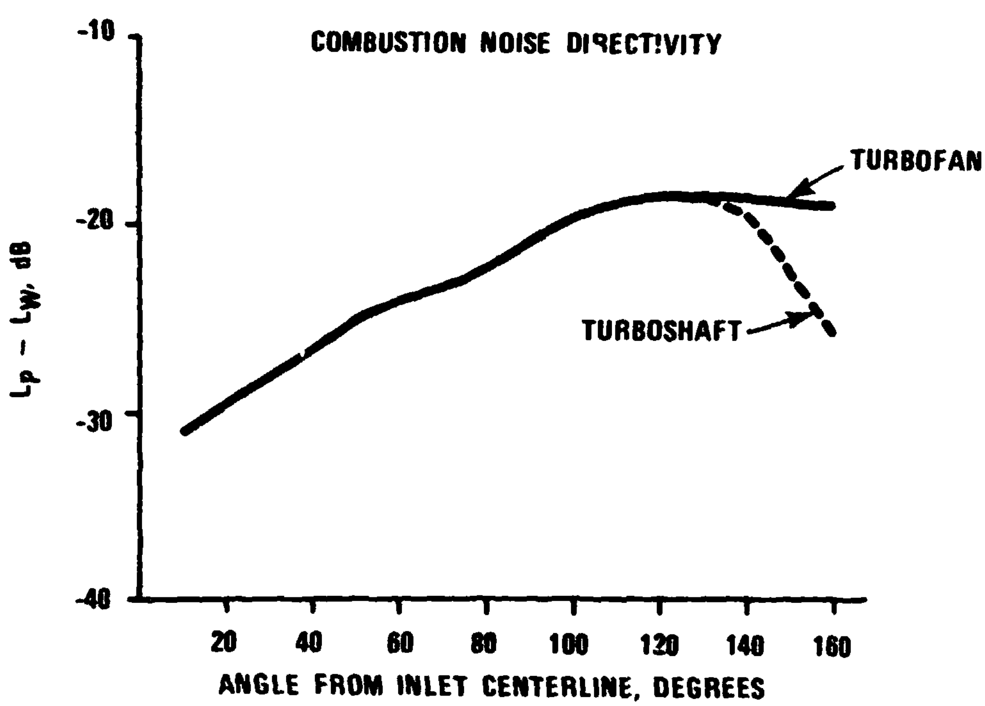

Figure 21. Combustion Noise Directivity.

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The prediction procedure is successful in correlating combustion noise over a significant size range of engines. Figures 22 and 23 compare predictions with static JT15D measured 1/3-octave sound pressure level data that has jet and turbine predicted levels subtracted from it so that only high frequency compressor and low frequency combustor sound levels remain. This component removal procedure gives visibility to the relevant low frequency segment of

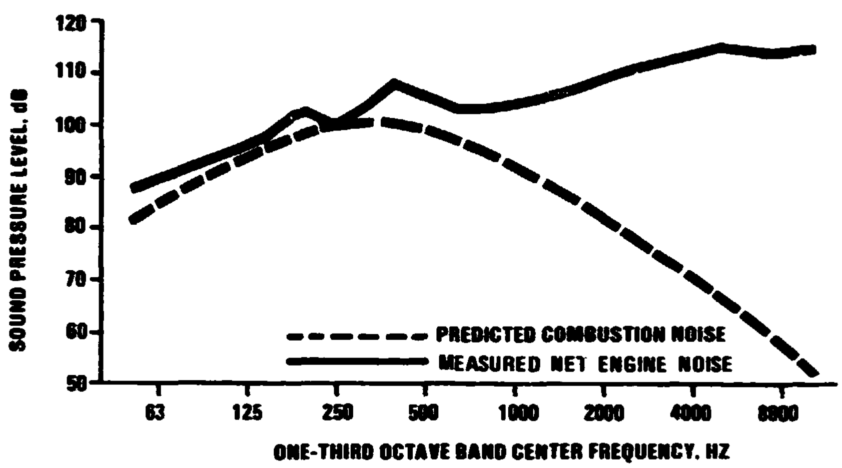

Figure 22. JT15D Combustion Noise Comparison, 50 Degrees Approach Power Predicted Jet and Turbine Noise Removed from Data.

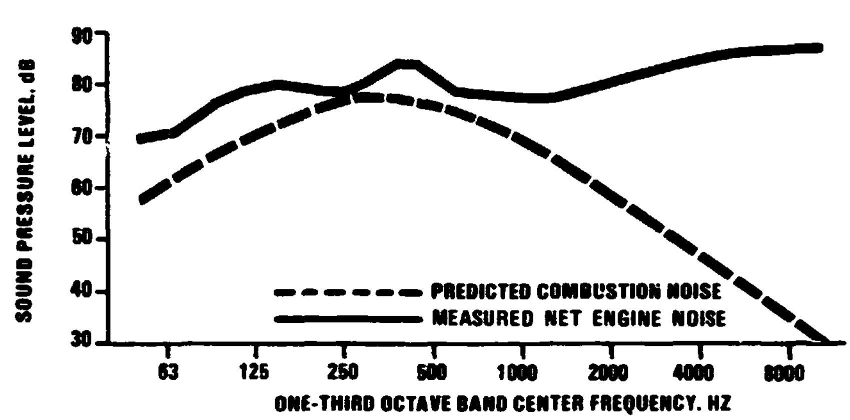

Figure 23. JT15D Combustion Noise Comparison, 120 Degrees Approach Power Predicted Jet and Turbine Noise Removed from Data.

the measured data, showing that the peak 1/3-octave level prediction does compare favorably. Reasonable agreement in spectrum shape is obtained in the forward quadrant. In the aft quandrant, excess core noise below 200 Hz is unaccounted for in the prediction.

Figures 24 and 25 show that good agreement was obtained when comparing static TPE331 turboprop data with the prediction model. The data is dominated by combustor and compressor noise. Jet

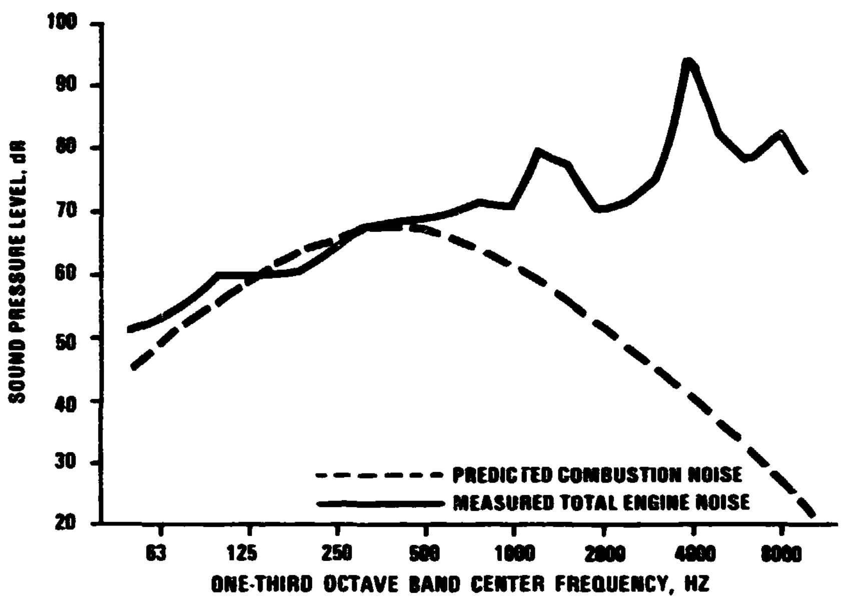

Figure 24. TPE331 Combustion Noise Comparison, 60 Degrees.

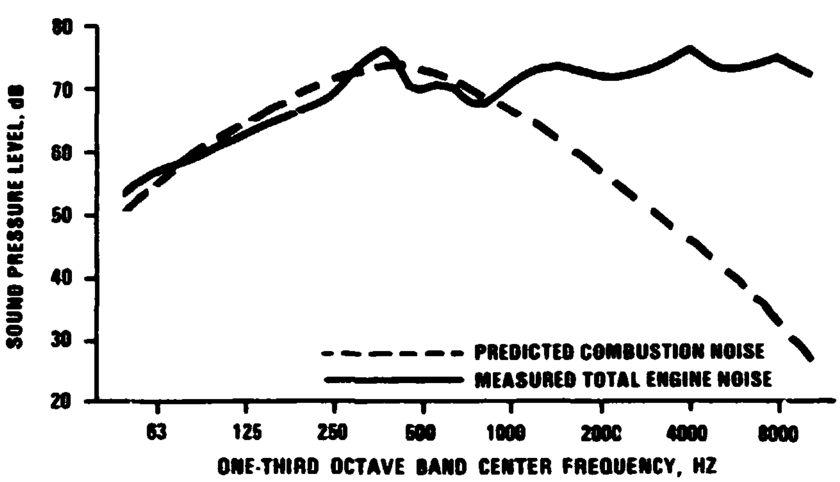

Figure 25. TPE331 Combustion Noise Comparison, 120 Degrees.

noise is not significant because of the low discharge velocity, and the turbine noise is insignificant because the blade passage frequencies occur above 20 kHz. Good agreement is also obtained between predictions and measured small APU core noise. Figures 26 and 27 compare predictions with the GTCP36 series APU (140 equivalent SHP output) at the peak radiation angle, 120 degrees, and at 150 degrees. This data is composed only of high frequency radial

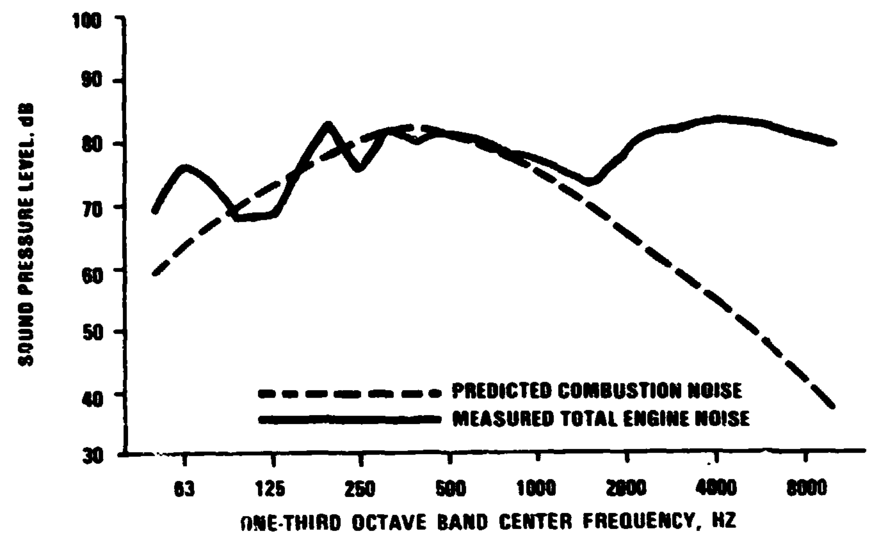

Figure 26. GTCP36 Series Combustion Noise Comparison, 120 Degrees.

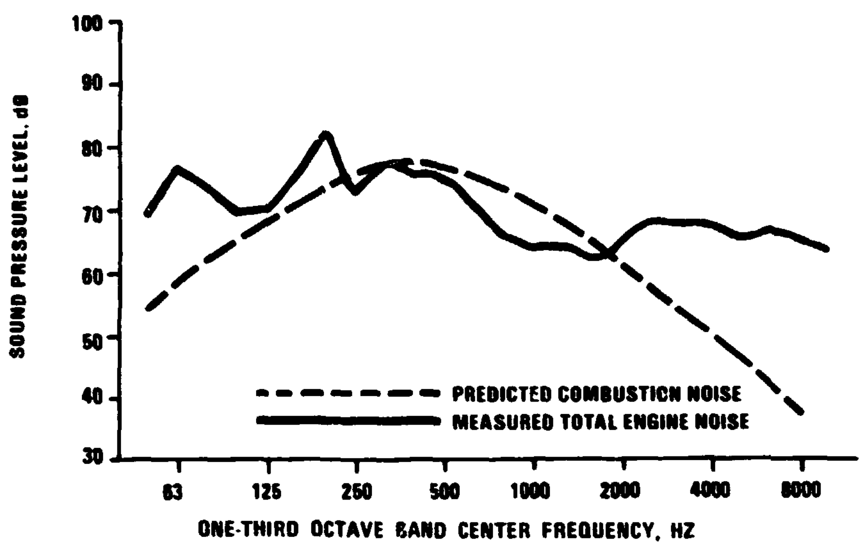

Figure 27. GTCP36 Series Combustion Noise Comparison, 150 Degrees.

turbine and low frequency combustor exhaust noise. Inlet compressor noise was isolated during the test. The peak frequency level is slightly overpredicted, but the spectrum shape is satisfactory, neglecting the tailpipe resonances below 500 Hz.

The combustor prediction procedure developed from the methods of refs. 6, 7 and 8 was found to correlate the full range of general aviation turbine engines more consistently than the individual methods. The parametric expression of ref. 8 provided the best correlation of turbofan and turboprop combustor noise sound power level, but failed to correlate APU data, whereas ref. 7 did provide a reasonable correlation. The poor correlation of the APU data by ref. 8 may be related to the turbine transmission loss expression, as this expression apparently underpredicts the combustion noise transmission loss through the turbine. Further work is required in correlation of small engine turbine transmission loss, and particularly radial turbine transmission loss.

3.4.5 Jet Noise Module (JET81)

The jet noise module is based on the prediction procedures developed at NASA-LeRC by J. Stone, refs. 2 and 9. It has the capability to predict accurately the static or in-flight noise levels generated by a jet exhausting from either a coaxial or single-jet nozzle normally used on general aviation turbofan or turbojet engines.

JET81 was created from a computer code provided by NASA-LeRC, and no significant modifications were made to the code. The methodology for the jet noise prediction procedure is shown schematically in Figure 28.

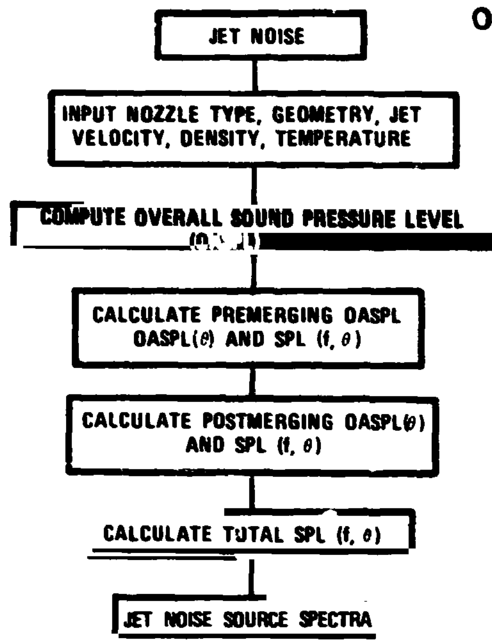

Figure 28. Jet Noise Prediction Methodology.

The jet module was verified for single and coaxial jet data contained in the above references. Total agreement was found between the JET81 code and the published results. Further validation studies were performed comparing predicted jet noise levels with data from NASA JT15D test data and from Garrett QCGAT, TPE331, and APU test data. The QCGAT engine is representative of general aviation turbofans with coaxial nozzles. Engine measurements and predictions are presented at takeoff power where the jet noise is assumed to dominate over the combustor noise at low frequencies. At the higher frequencies, deviations from the predicted jet noise are due to noise contributions of other engine components. (A typical comparison between predicted and measured jet noise spectra at 140 degrees from the inlet axis is shown in Figure 29.) The jet noise directivity at 250 Hz, the predicted peak frequency, is presented in Figure 30. Good overall agreement between predicted and measured coaxial jet noise is observed.

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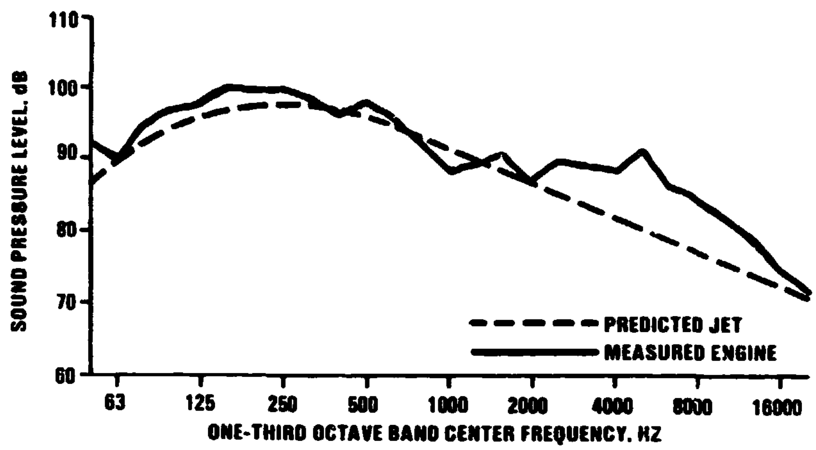

Figure 29. QCGAT Jet Noise Comparison, Hardwall r, Coannular Nozzle, Takeoff Power, 140 Degrees from Inlet Axis.

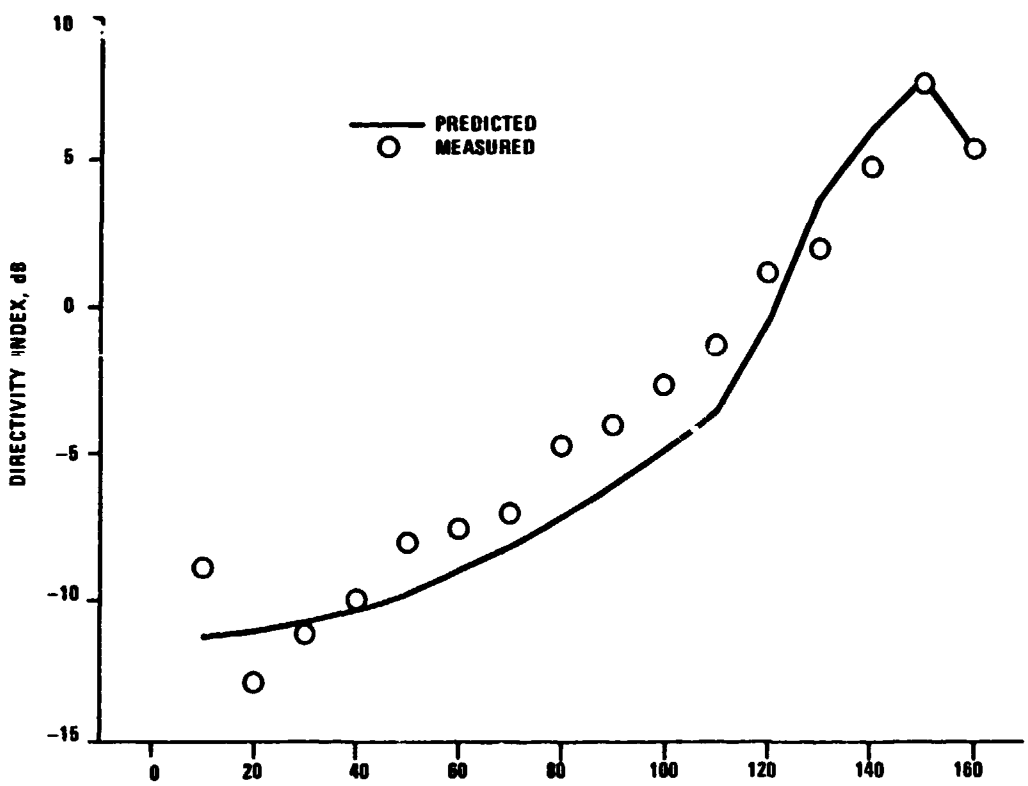

Figure 30. Directivity Index at 250-Hz Octave Band QCGAT Hardwall Coannular Nozzle at Takeoff Power.

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The TPE331 engine is representative of general aviation turboprops with single-jet exhausts. Excellent agreement between predicted and measured jet noise spectra at 160 degrees from the inlet axis was obtained as shown in Figure 31. The directivity of the 250-Hz peak frequency jet noise is presented in Figure 32. Good agreement is observed between predicted and measured directivity indices.

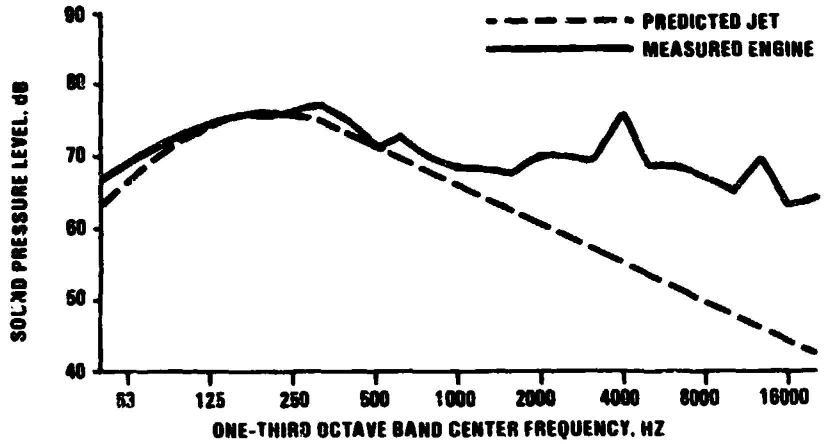

Figure 31. TPE331 Jet Noise Comparison, 100-Percent rpm, Full Power, 160 Degrees from Inlet Axis.

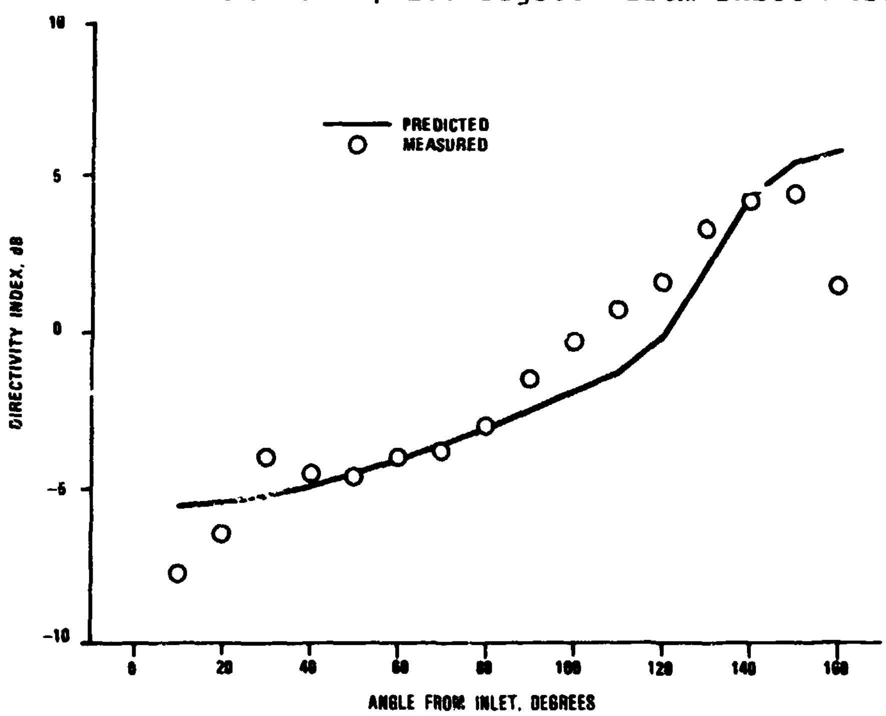

Figure 32. Directivity Index at 250-Hz Octave Band TPE331 at Takeoff Power, Circular Diffuser.

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The jet noise prediction module provides good agreement with measured JT15D turbofan jet noise levels at takeoff condition as shown by Figures 33 through 35. Excellent agreement exists between predicted and measured jet noise levels at all angles up to 140 degrees. Typical comparisons for the 90-degree and 130- degree cases are shown in Figures 33 and 34. At 150 degrees, the predicted jet noise levels are slightly below the measured levels, with the peak frequency of the jet noise shifted two 1/3-octave bands, as shown in Figure 35.

In summary, the jet noise prediction procedures based on refs. 2 and 9 provide good agreement with measured jet noise levels for all engines in the available general aviation data base.

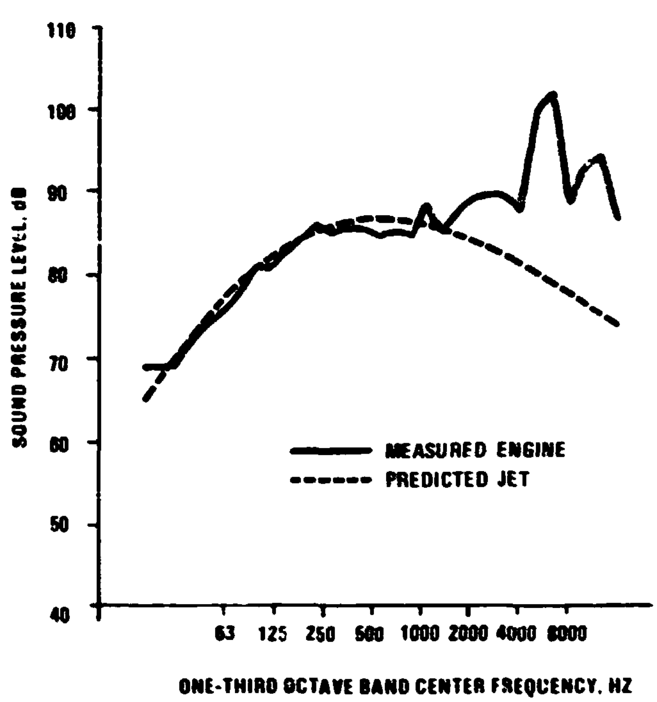

Figure 33. JT15D Jet Noise Comparison at Takeoff Condition at 90 Degrees from Inlet Axis

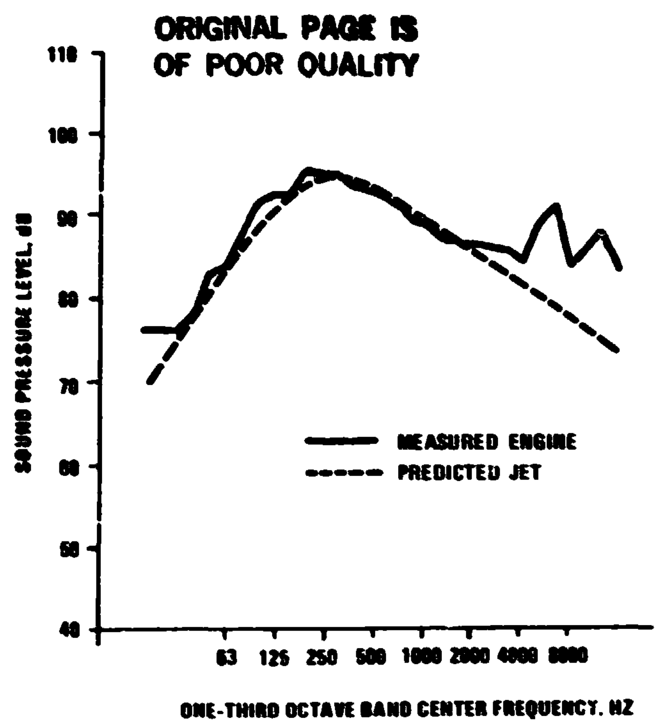

Figure 34. JT15D Jet Noise Comparison, at Takeoff Condition, at 130 Degrees from Inlet Axis.

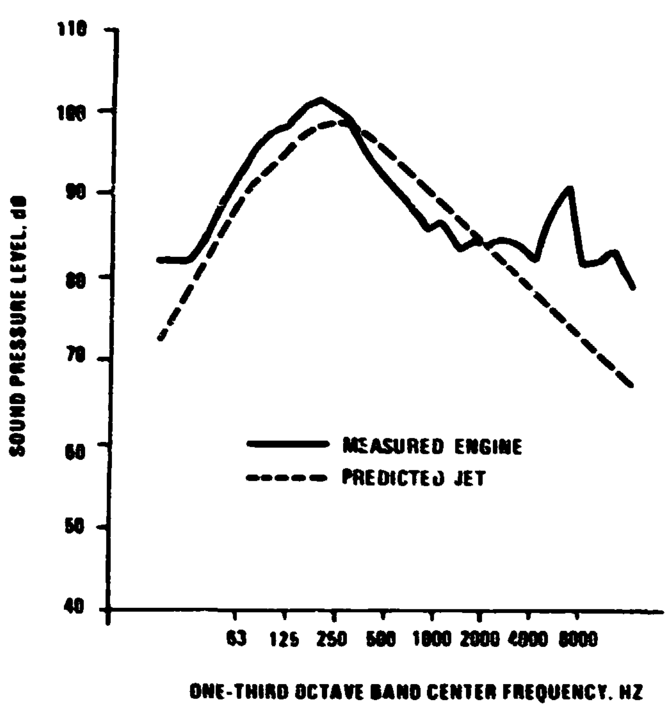

Figure 35. JT15D Jet Noise Comparison at Takeoff Condition at 150 Degrees from Inlet Axis.

3.4.6 Turbine Noise Module (TURBIN)

The axial and radial turbine noise prediction methodology is based on the General Electric "Preliminary Prediction Procedure" of (ref. 10) and by their unpublished submittal to the SAE A-21 Committee, (ref. 11). The Preliminary Method is based on turbine parameters readily available during preliminary design and predicts total turbine noise, rather than synthesizing the total signature from individual turbine stage predictions. No distinction is made in prediction methodology between axial and radial turbines. The turbine cycle parameters used to correlate axial turbine noise are sufficient to correlate radial turbine noise. The primary differences in the noise prediction calculations for the two types of turbines are the empirical constants used in the prediction equation and the empirical directivity and frequency spectrum tables of ref. 10. Figure 36 outlines the methodology used for turbine noise prediction.

The turbine procedure is based on the peak overall sound pressure level, occurring at 110 degrees from the inlet centerline. The peak overall sound pressure level for axial turbines is given by

$$L_{P_{Peak}} = 40 \log_{10} (\Delta T/T) - 20 \log (V_t) + 10 \log (A) + 164.$$

where

$\Delta T/T = 1 - (1/P_R)^{(K-1)/K}$, turbine normalized ideal work extraction

P_R = Turbine total to static pressure ratio

V_t = Blade tip speed of last stage, ft/sec

A= Actual turbine nozzle exit area, ft^2

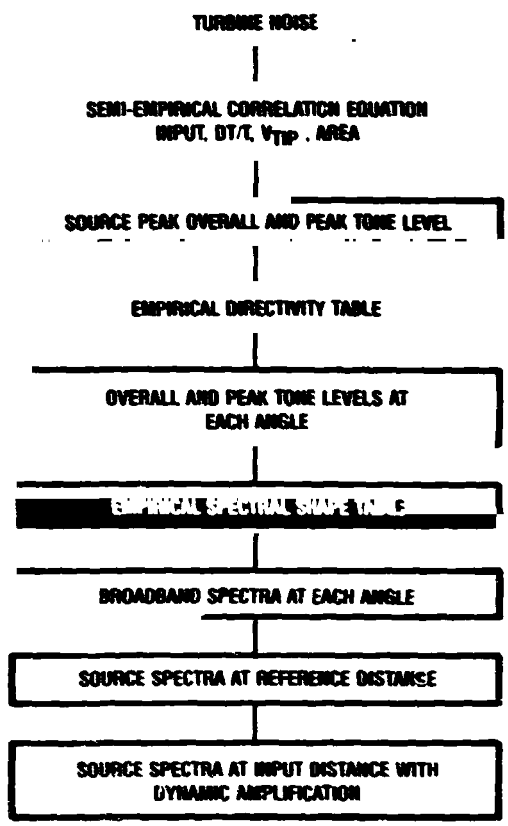

Figure 36. Turbine Noise Prediction Methodology.

The above equation predicts the peak overall sound level at 70.4 meters (231 ft) and contains standard day atmospheric absorption, extra ground attenuation, and ground reflection reinforcement of about 1.5 dB at high frequencies.

The corresponding radial turbine peak overall sound level relationship is given by

$$L_{P_{Peak}} = 8.75 \log (\Delta T/T) - 20 \log (V_t) + 10 \log (A) + 167.5$$

for a source-receiver distance of 7.6 meters (25 ft). It contains only FAA standard day atmospheric absorption.

The axial turbine peak tone level at the turbine blade passage frequency is computed from

$$L_{P_{tone}} = 40 \log (\Delta T/T) - 20 \log (V_t) + 10 \log (A) + 165\text{-CORR}$$

where

CORR = FAA standard day atmospheric correction + extra ground attenuation at 70.4 meters (231 ft), dB.

The axial turbine peak overall and peak tone levels both contain atmospheric absorption and extra ground attenuation at 70.4 meters (231 ft).

The radial turbine peak tone level at 7.6 meters (25 ft) is given by

$$L_{P_{tone}} = 20 \log (\Delta T/T) -20 \log (V_t) + 10 \log(A) + 165$$

The overall sound level and peak tone level at each angle are determined, using the directivity corrections (DI) illustrated in Figures 37 and 38, by the expressions

$$L_{P_{oa}}(\theta) = L_{P_{Peak}} - DI(\theta)$$

$$L_{P_{tone}}(\theta) = L_{P_{tone}} - DI(\theta)$$

The directivity table of ref. 10 was revised, redefining the overall and tone sound pressure level corrections and eliminating the distinction between approach and takeoff conditions. The resulting directivity corrections peak at 110 degrees, have a much sharper drop-off on either side of the peak angle and are used for both approach and takeoff conditions.

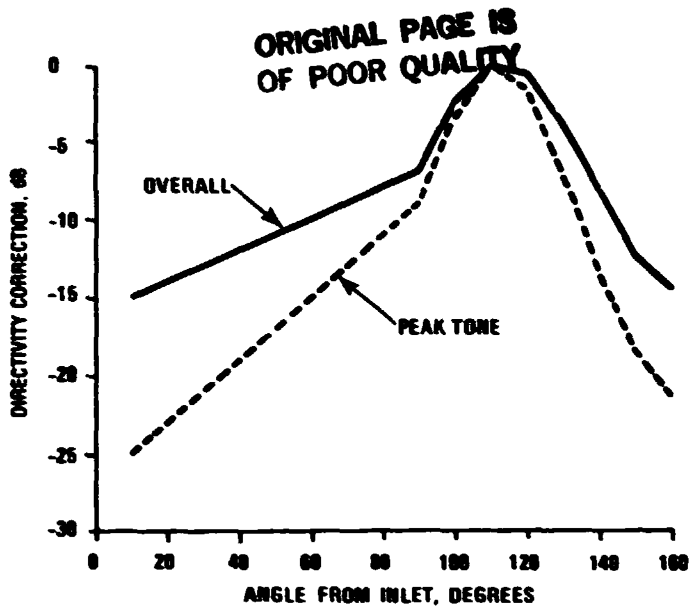

Figure 37. Axial Turbine Overall And Peak Tone Level Directivity Corrections.

As shown in Figure 38, no distinction is made between radial turbine overall and tone directivity corrections. The one set of corrections is used for both approach and takeoff conditions.

The overall broadband sound level determined by subtracting the fundamental blade passage tone from the overall sound level at each angle is given by

$$L_{P_{BB,oa}} = 10 \log \left[10^{(L_{P_{oa}}/10)} - 10^{(L_{P_{tone}}/10)} \right]$$

The broadband frequency spectrum, $L_{P_{BB}}$, is obtained from empirical tables, illustrated in Figures 39 and 40. The peak frequency of radial turbine broadband noise, 5000 Hz, is independent of speed, number of blades, and turbine diameter when correlated with available Garrett radial turbine data. The spectrum roll-off has been observed to change with engines, but no simple parameters have been determined which correlate this change in rolloff.

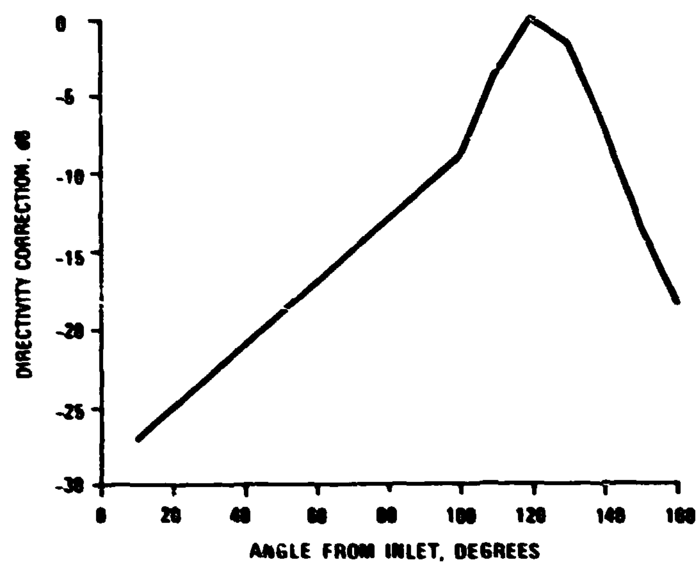

Figure 38. Radial Turbine Directivity Correction.

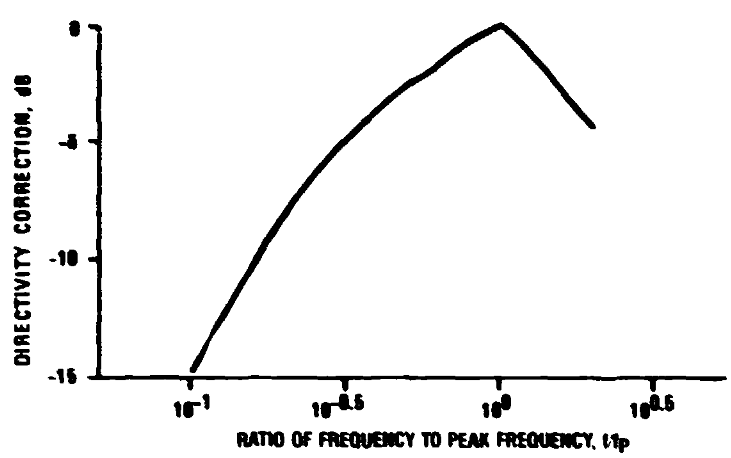

Figure 39. Normalized Axial Turbine Broadband Spectrum.

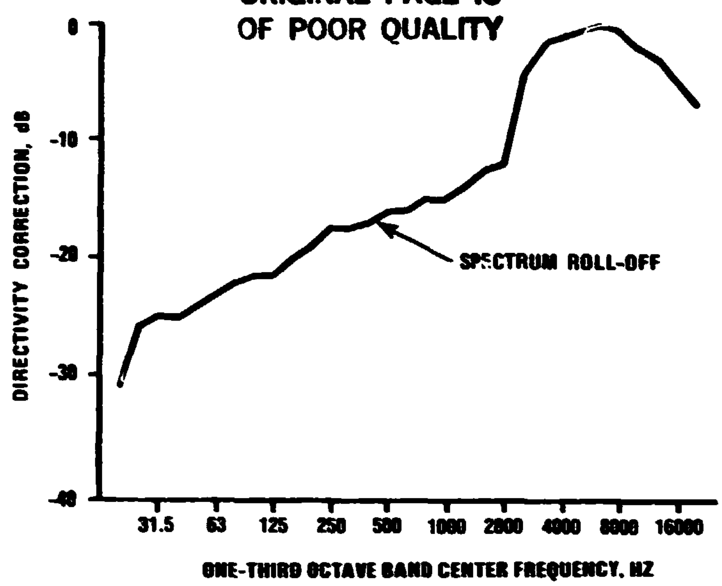

Figure 40. Radial Turbine Broadband Spectrum.

The overall sound level spectrum is obtained for each frequency and angle as the sum of the tone and broadband levels, given by

$$L_P = 10 \log \left(10^{(L_{P_{BB}}/10)} + 10^{(L_{P_{tone}}/10)} \right)$$

The spectrum is then adjusted to the input distance by computing and adding the necessary corrections for spherical spreading and atmospheric absorption. For axial turbines, the extra ground attenuation at 70.4 meters (231 ft), 1.85 dB, is retained because it compensates for the high frequency ground reflection reinforcement of approximately 1.5 dB.

Verification of the axial turbine methodology was conducted primarily on turbofan engines. The peak tone frequency on available general aviation turboshaft and APU data is above the highest frequency of interest, 20,000 Hz. Figures 41 and 42 compare QCGAT measured total engine sound level data and turbine sound level predictions at approach and takeoff power settings for a 110 degree radiation angle. Combustion, jet, and compressor component levels

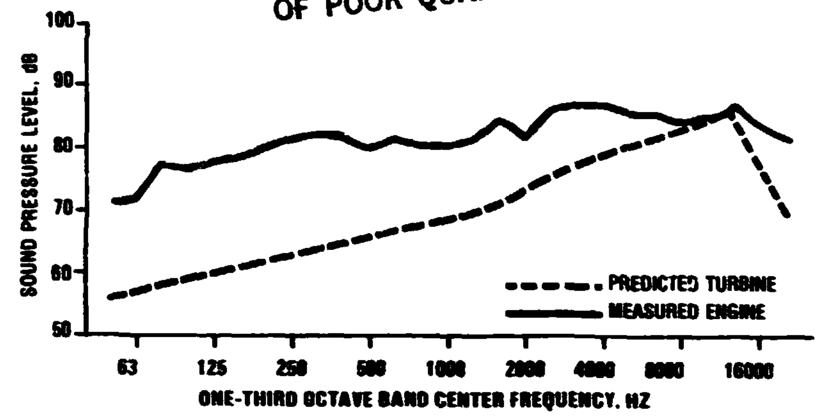

Figure 41. QCGAT Hardwall Coannular, Approach Power, 110 Degrees.

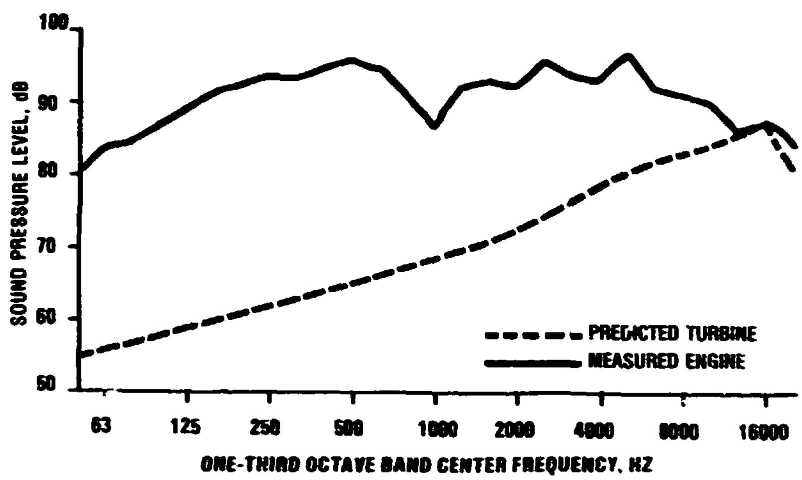

Figure 42. QCGAT Hardwall Coannular, Takeoff Power, 110 Degrees.

were not removed from the data. The peak tone level is underpredicted by 2 dB at approach, but is in excellent agreement at takeoff. Similar comparisons with JT15D measured data are shown in Figures 43 and 44, but results are difficult to interpret because the measured sound spectrum is dominated by the fan fundamental and second harmonic at the radiation angle of maximum turbine tone sound level.

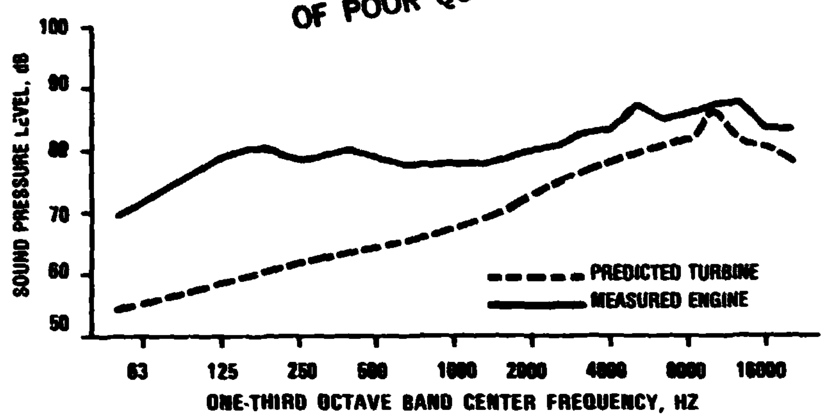

Figure 43. JT15D Approach Power, 110 Degrees.

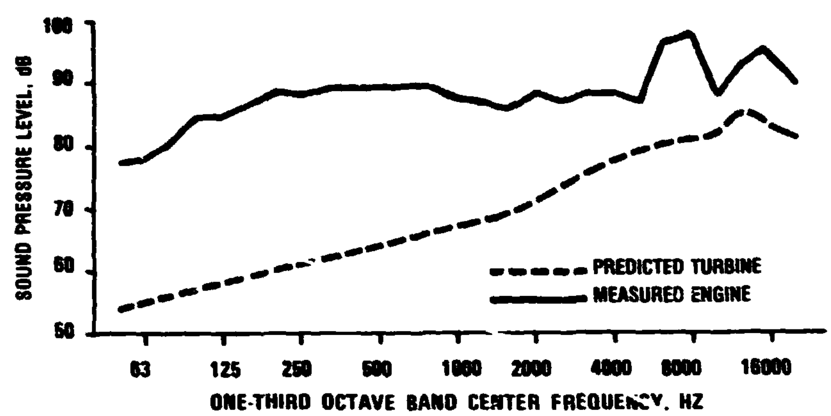

Figure 44. JT15D Takeoff Power, 110 Degrees.

The radial turbine noise prediction methodology was validated with measured data acquired on the GTCP36 series and GTCP85 series APU models. The 36 series APU models use a reverse annular combustor rather than a can combustor used on the 85 series models and have a 20-percent smaller turbine wheel diameter than the 85 models. The broadband spectrum shape, derived from the GTCP36

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series APU, shows good agreement in Figures 45 and 46. Figures 47 and 48 compare predictions with GTCP85 series APU data. Blade tone and broadband sound levels correlate very well but the predicted broadband spectrum shape is too broad.

In summary, predicted axial turbine peak tone levels agree with measured data to within 2 dB. This agreement was achieved by defining a new overall directivity pattern to obtain overall and peak tone sound level directivity corrections. Radial turbine sound level correlation was achieved using the same engine-cycle parameters required by the axial turbine prediction methodology. Good correlation of radial turbine peak tone level and peak broadband level was obtained, but the broadband spectrum shape showed a variation with engine model not accounted for in the prediction procedure.

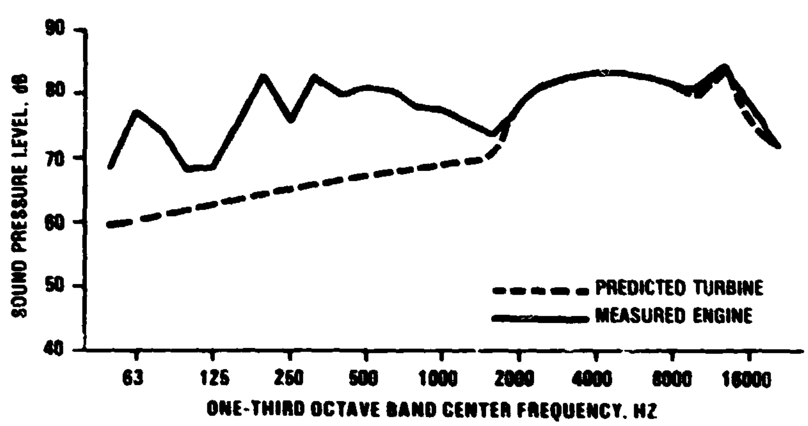

Figure 45. GTCP36 Series Radial Turbine, 120 Degrees.

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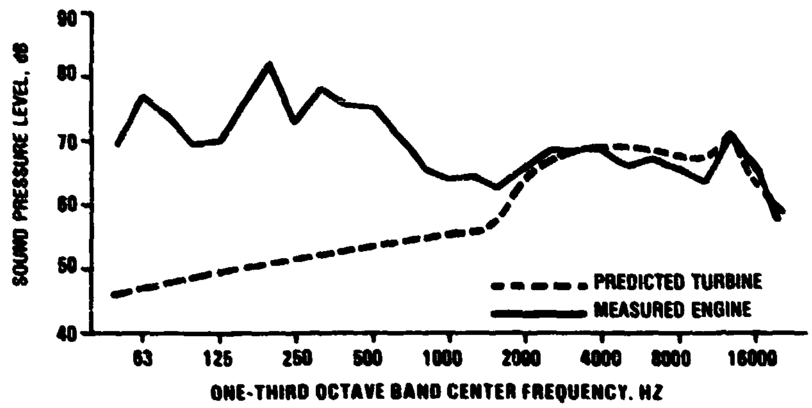

Figure 46. GTCP36 Series APU Radial Turbine, 150 Degrees.

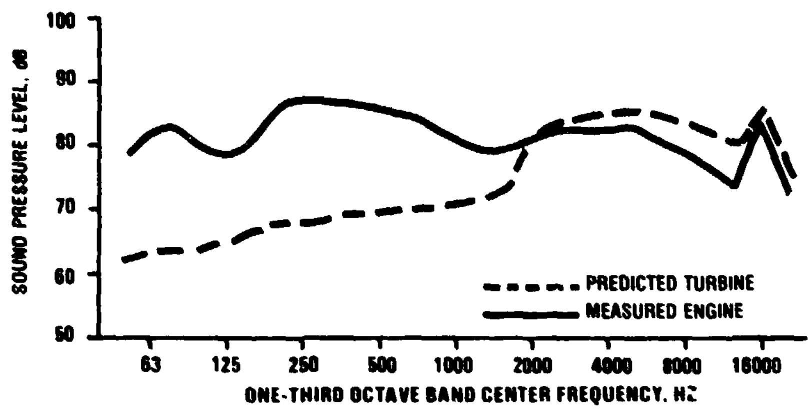

Figure 47. GTCP85 Series APU Radial Turbine, 120 Degrees.

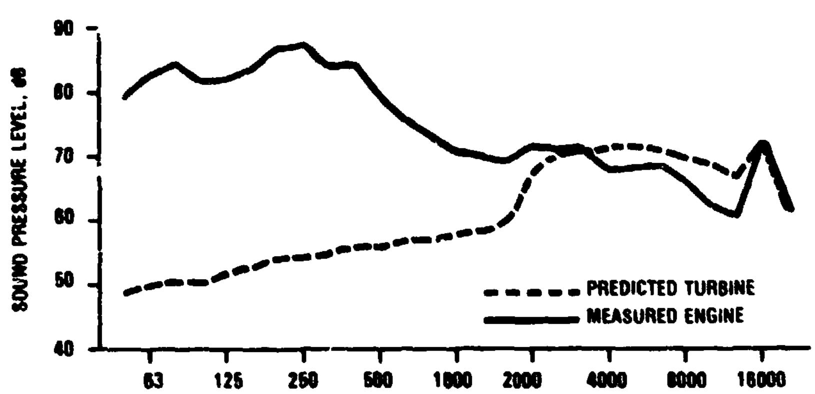

Figure 48. GTCP85 Series APU Radial Turbine, 150 Degrees.

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3.4.7 Propeller Noise Module

Subroutine FFPROP calculates far-field noise for propeller aircraft, based on the graphical procedure described in SAE Aerospace Information Report AIR 1407, ref. 12, and modified to generate a frequency spectrum using the procedure of ref. 13. A correction for swept blades is included from ref. 14. A vortex noise routine, based on ref. 15, is also included.

Overall sound pressure level is determined in the main subroutine. The directivity index, relative harmonic levels, far-field swept blade correction, and vortex noise are calculated in separate subroutines. Program flow is shown in Figure 49.

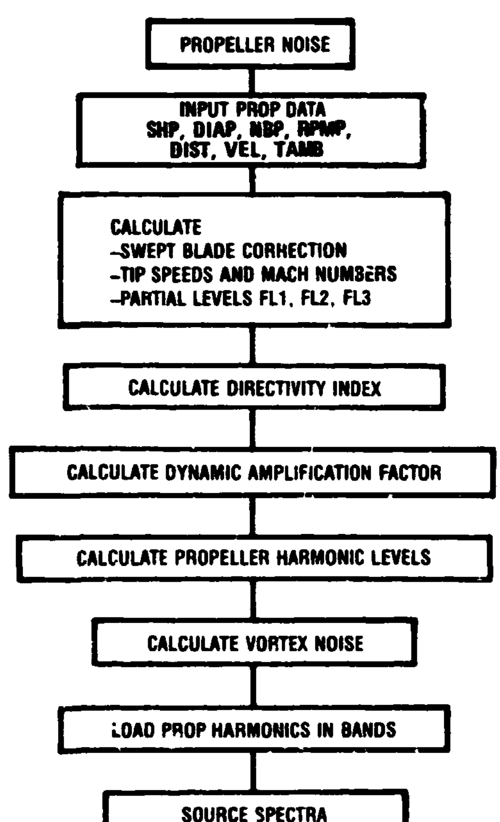

Figure 49. Propeller Noise Prediction Methodology.

Figures 1, 2, and 3 in Appendix B, taken from the graphical procedure of ref. 12, were converted into the following equations:

$$FL1 = 16 \log (SHP) + 38 M_R + 16$$

$$FL2 = -20 \log NBP \cdot DIAP + 33$$

$$FL3 = -20 \log (R) + 54$$

where

FL1, FL2, and FL3 are far-field partial levels, dB
SHP is the shaft power per engine
M_R is the propeller rotational tip Mach number
NBP is the number of blades
DIAP is the propeller diameter, ft.
R is the distance between the propeller and observer, ft.

The overall sound pressure level is the sum of the three partial levels corrected for directivity and swept blades.

The directivity index, swept blade correction, relative harmonic levels, and blade vortex noise are calculated in smaller subroutines described below.

- <u>SUBROUTINE DI</u> - This subroutine calculates the directivity index of propeller noise based on Figure 4, Appendix B (ref. 12). The routine consists of a cubic spline fit through the directivity index curve. The cubic constants are in data statements in the subroutine.

- <u>SUBROUTINE FFHAR</u> - This subroutine calculates the relative harmonic levels for the first 20 harmonics and is based on the graphical technique presented on Figure 5, Appendix B (ref. 13). The routine consists of arrays that represent curves from the reference figure. Corre-

lations of calculations and measurements indicated that an assumption of harmonic levels for 5 bladed propellers resulted in better predictions for all 2-, 3-, and 4-bladed propellers.

- <u>FUNCTION FFSWP</u> - This function subroutine calculates a correction to far-field noise for swept blades and is based on Figure 6, Appendix B (ref. 14). The routine consists of piecewise cubic fits of the curves of the reference figure, and the cubic constants are listed in data statements in the routine.

- <u>SUBROUTINE BANDS</u> - This subroutine calculates propeller vortex noise in 1/3-octave bands and also adds the propeller harmonics to the appropriate bands. The vortex (broadband) noise is based on the method of ref. 15. The dynamic amplification factor (CAEP) for the propeller harmonics is defaulted to 40. in the input subroutine; however, the propeller vortex noise dynamic amplification factor is always set at 10.

Verification of the propeller methodology was conducted using Twin Otter measured data from ref. 22. Comparisons of predicted and measured propeller noise spectra are shown in Figures 50 and 51. The measured data shown was acquired during level flight using two wingtip microphones, one mounted on a wingtip boom in the propeller plane, and one mounted on the trailing edge of the wingtip. The predicted spectra were corrected to these microphone locations. The figures show good agreement between measured and predicted levels. The difference between measurement and prediction for the aft wingtip microphone (Figure 51) at high frequencies is thought to be due to wing shielding

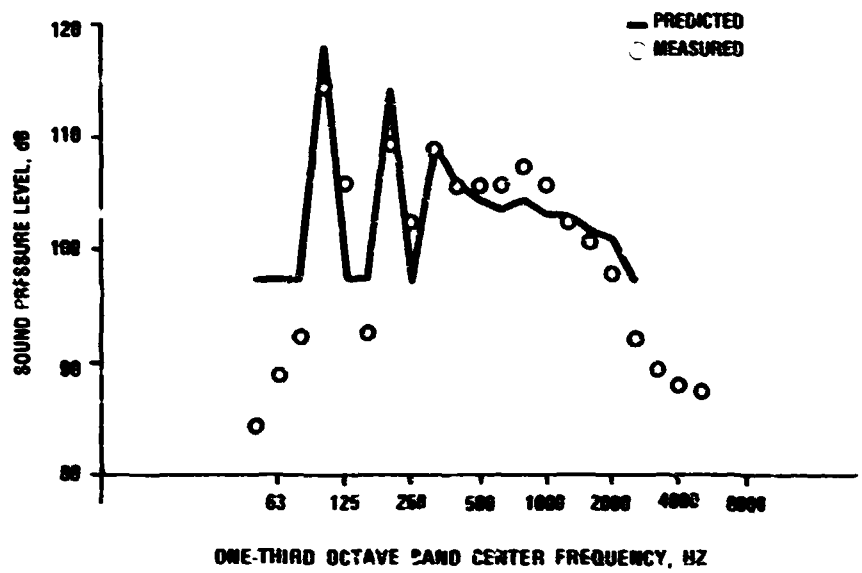

Figure 50. Comparison of Predicted and Measured Propeller Noise Spectra, 90 Degrees from Propeller Axis.

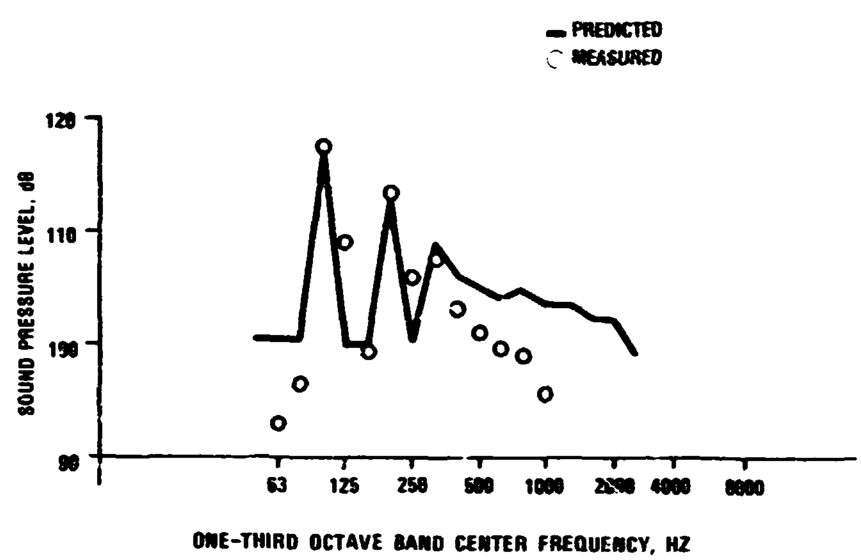

Figure 51. Comparison of Predicted and Measured Propeller Noise Spectra, 112 Degrees from Propeller Axis.

3.4.8 Cabin Noise Module (CABIN)

The CABIN module calculates aircraft cabin noise for multi-engine propeller or jet aircraft. The routine calculates both propeller and boundary layer noise. The basis for the program is a graphical procedure developed for NASA-Lewis by Hamilton-Standard and described in ref. 14. Each of the 12 graphs in this procedure was converted into equation form or was approximated by linear or cubic equations using curve fitting techniques. Figure 52 shows the normal program flow of the CABIN module.

Cabin normally calculates propeller and boundary layer noise separately and then totals the two. If it is used for nonpropeller aircraft, the default propeller data will be calculated, but only the boundary layer noise should be considered. Engine noise is not included, so aft cabin boundary layer noise calculations may be lower than measured levels.

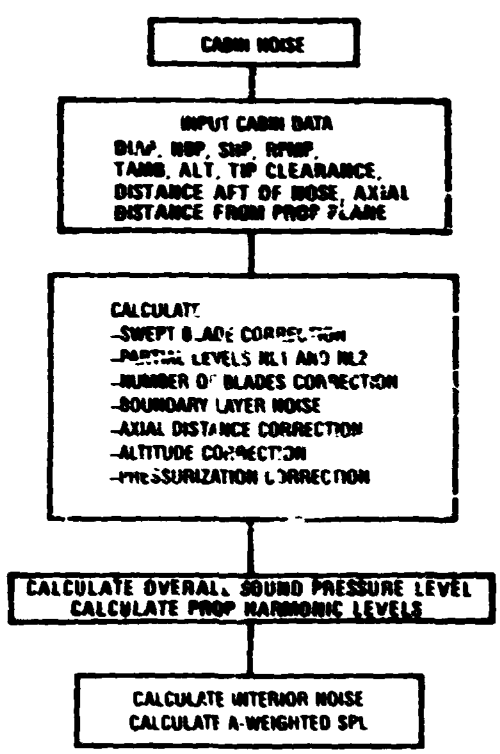

Figure 52. Cabin Noise Prediction Methodology.

CABIN includes equations for the first two graphs of ref. 14. The first equation represents a partial near field level based on horsepower and propeller diameter (from Figure 7, Appendix B), and is given by:

$$NL1 = 135 + 15 \log (SHP) - 40.336 \log (DIAP)$$

where SHP is the shaft horsepower absorbed by the propeller and DIAP is the diameter of the propeller. The second graph in the reference procedure is a correction for radial distance from the propeller tip and reference tip Mach number (from Figure 8, Appendix B). The equation for this graph is

$$NL2 = 12 - [14 + 40 (1-M_T)] \left(1 + \frac{\log (Y/D)}{1.523}\right)$$

where

Y/D is the dimensionless radial tip-fuselage clearance (Y) normalized by D, the propeller diameter, and M_T is a reference tip Mach number defined as follows:

M_T = rotational tip Mach number, M_R, for $M_{TH} \leq 0.85$

$$M_T = M_R + \frac{(M_{TH}-0.85)}{0.05} (M_{TH}-M_R) \qquad 0.85 < M_{TH} < 0.9$$

M_T = helical tip Mach number, M_{TH}, for $M_{TH} \geq 0.9$

Other calculations for CABIN are described in the individual smaller subroutines described below.

- <u>SUBROUTINE RELHAR</u> - This subroutine calculates the relative levels of the first ten propeller harmonics, as a function of helical tip Mach number. The routine is based on the data in Figure 9, Appendix B (ref. 14). Figure 53 shows a computer-generated equivalent of part of Figure 27 of ref. 14 which was calculated by RELHAR to

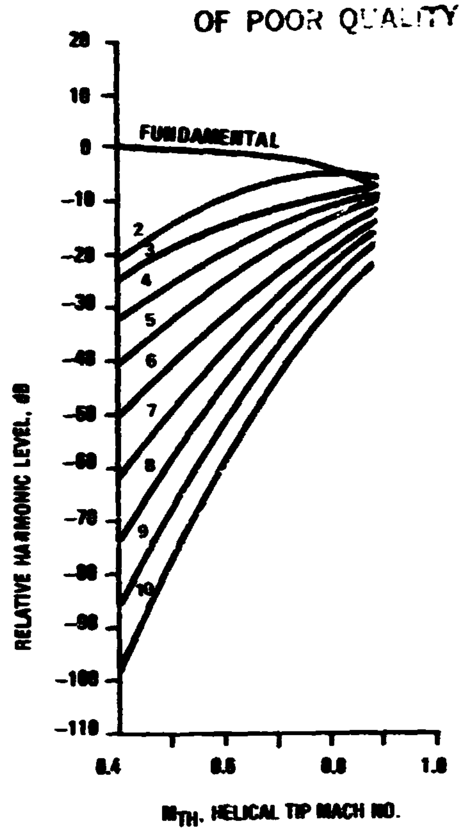

Figure 53. Near-Field Harmonic Distribution of 2-Bladed Propeller.

test the subroutine. The constants for a cubic equation for each curve in the referenced figure were calculated and stored in data statements in RELHAR. RELHAR also normalizes the relative harmonic level. The procedure is based on data for 2, 3, 4, 6, or 8 bladed propellers. Five bladed propellers are treated as four, seven bladed propellers are treated as six, and more than eight are treated as eight bladed propellers.

- <u>SUBROUTINE AXIAL</u> - This subroutine calculates the axial-correction for variations in propeller noise in the fore and aft direction from the propeller disk. The routine

is based on Figure 10, Appendix B (ref. 14). Cubic equations were piecewise fit to the four curves in that figure.

Linear interpolation is performed in the subroutine for values between the curves. In order to extrapolate beyond the values in the above mentioned figure, an equation was assumed which was of the form

$$XC = -20 \log \left[1 + \left(\frac{X/D}{\text{constant}}\right)^2\right]$$

By choosing the correct constant in this equation, the slope and absolute value of the endpoint of each curve in the referenced figure were matched. The four curves in the referenced figure are generated by functions ONE, TWO, THREE, and FOUR where the data statements with the cubic constants are located.

- SUBROUTINE PRCOR - This routine calculates a correction factor for cabin pressurization that is based on Figure 11, Appendix B (ref. 14). Linear equations were piecewise fit to the six curves in that figure, which are calculated by functions CRVA, CRVB, CRVC, CRVD, CRVE, and CRVF. Linear interpolation is performed in PRCOR for values between the six curves.

- SUBROUTINE TL - This subroutine calculates the transmission loss of the fuselage and is based on Figure 12, Appendix B (ref. 14). The transmission loss, in dB, is a function of frequency and is represented mathematically as follows:

$TL = 33$	$0 < f \leq 400$
$TL = 33 + (17/560)(f-400)$	$400 < f \leq 960$
$TL = 50$	$960 < f$

o SUBROUTINE BLSPL - This routine calculates the boundary layer noise on the exterior of the fuselage and is based on Figures 13, 14, 15, and 16, Appendix B (ref. 14). Figure 13, Appendix B, determines the overall boundary layer noise as a function of altitude and flight speed. The equation derived from the data in Figure 13, Appendix B, is as follows:

$$L_{P_{oa}} = 40 \log V - 0.23 \text{ ALT} - \left(\frac{\text{ALT}}{25.4}\right)^2 + 33.9$$

where V is aircraft velocity in knots and ALT is altitude in thousands of feet.

Figures 14, 15, and 16, Appendix B, are used to determine the 1/3-octave spectra of the boundary layer noise relative to the overall level. Figure 14, Appendix B, determines a reference frequency which is used to predict the peak level frequency. The following equation closely approximates the data in the figure:

$$f_{ref} = 22.0\ V^{1.215}/d^{0.79}$$

where V is velocity in feet per second and d is the distance aft of the airplane nose in feet. Figure 15, Appendix B, gives a reference frequency multiplier to determine the peak frequency as a function of altitude. Piecewise linear equations were fit to the curve of that figure.

Figure 16, Appendix B, is a normalized spectrum shape centered on the frequency of maximum noise level described above. The spectrum shape is loaded into an array through data statements, and calculations are made for that part of the spectrum where the relationship is linear.

The subroutine determines which 1/3-octave band the center frequency falls within, and adjusts the spectrum shape frequencywise so that the maximum level is in that band. The 20-Hz to 20,000-Hz spectrum is then normalized and added to the overall level.

- FUNCTION AWATE - This function returns the appropriate A-weighting for arbitrary discrete tones from 10 Hz to 20,000 Hz. This function is used to calculate the A-weighted sound level for propeller noise. (A-weighting is a continuous smooth function of frequency, and putting the propeller tones in appropriate 1/3-octave bands and weighting the bands creates some error.)

AWATE is based on a cubic spline fit through the A-weighting constants, and the resulting cubic constants are stored in data statements in the function subroutine.

- FUNCTION SWEEP - This function calculates the correction factor for swept blades and is based on Figure 17, Appendix B, (ref. 14). Cubic equations were fit to the data in this figure and the resulting constants are stored in data statements in the function subroutine.

- FUNCTION CABALT - This function returns an altitude correction to cabin noise calculations based on Figure 18, Appendix B, (ref. 14). Linear equations were piecewise fit to the monotonic function in the referenced figure.

The output for CABIN is written in a long and short format. The short format is only 20 lines long and lists only the inputs and propeller noise. It was designed for interactive terminal use, and has been removed through comment statements in the NOISE program.

The long form includes input, boundary layer noise, calculated constants, and predicted noise levels.

The CABIN module procedure was verified with measured cabin noise data from twin-engine reciprocating and turboprop-powered executive aircraft. Good agreement was obtained, as shown in Sample Test Case 5 of Appendix A.

3.5 Aircraft Flyover Noise Level Predictions

3.5.1 Flyover Control Module (FLYCON)

Subroutine FLYCON is the control module for the execution of all flyover procedures. It calls the primary flyover module (subroutine FLYOVR) and the output module (subroutine PRINT).

The sideline condition requires special consideration. An iteration procedure is performed on sideline noise levels because the exact sideline observer location at which the maximum L_{EPN} occurs is not known beforehand. Therefore, an efficient iteration search, using the golden section method (ref. 20), is used to determine the maximum sideline L_{EPN}. Default observer range location boundary values are set at the aircraft rotation location and at the takeoff condition observer range location. The default value for the sideline range tolerance is set at 30.5 meters (100 ft.). Normally, 12 to 13 iterations are required to converge. The iteration time can be reduced if the user inputs initial range boundary values that are significantly closer together. The golden section method assumes that there is only one maximum L_{EPN} value between the range boundaries.

3.5.2 Flyover Noise Prediction Module (FLYOVR)

Subroutine FLYOVR predicts aircraft flyover noise levels for FAR 36 takeoff, sideline, approach and level flyover certification conditions. FLYOVR predicts L_{EPN}, L_{PN}, L_{TPN}, L_P and L_{PA} levels for each engine source and for the total aircraft noise in 0.5-second intervals along the user-specified acoustic flight path.

For each time interval on the flight path, the slant distance and engine-observer noise radiation angle are computed from direction cosines through a call to subroutine ORIENT. The previously calculated static noise spectra for each source are then interpolated at the engine-observer radiation angle to determine the source spectra radiated toward the observer at the time interval being analyzed.

Next, the flight noise spectra are adjusted for the following flight and propagation corrections:

Atmospheric Attenuation - Atmospheric attenuation is calculated in accordance with SAE ARP 866, ref. 16, for standard-day conditions of 77°F and 70-percent humidity along the entire flight path length. Subroutine ATMABS determines the atmospheric absorption at 304.8 meters (1000 ft.) for nonstandard ambient conditions during the static source prediction process.

Inverse Square Law - The noise reduction due to spherical divergence is calculated by

$$- \Delta dB = 20 \log \frac{\text{propagation distance}}{R}$$

where R is the source-observer distance used for the static predictions.

Number of Engines - The noise increase for the number of engines is calculated by

$$\Delta dB = 10 \log (\text{number of engines})$$

At takeoff and approach conditions for aircraft with more than one engine, and with the engines out of phase, this correction is reduced by 0.5 dB per engine.

Wing Shielding Effect - Turbofan and turbojet engine inlet noise levels are corrected by a call to subroutine WING to simulate the reduction due to wing shielding. There is no wing shielding provision for turboprop engine installations. Wing shielding effects are calculated based on the theory of diffraction around a barrier, as contained in ref. 17. The wing shielding model used in subroutine WING uses the actual engine/wing relational geometry of the referenced aircraft. The shielding effect on inlet radiated noise for a fuselage-mounted engine located over-the-wing is calculated based on the relative position of the aircraft with respect to FAR 36 measurement stations at each 1/2-second interval along the flight profile, as shown in Figure 54. Wing shielding corrections are made only for a fuselage-mounted engine installation. The variable LOCENG in NAMELIST &SYS is set to 1 to specify a fuselage-mounted engine. Wing shielding effects then are included for this engine installation if IWING in NAMELIST &FLY is set to 0 (default option).

The wing shielding procedure used is based on optical-diffraction (Fresnel) theory, which assumes that only the incident wavefield that is close to the leading edge or tip of the wing contributes appreciably to the wavefield defracted over the wing. The wing shielding effect is not restricted to the shadow zone (the region where the observer cannot see the sound source) but also affects a small transition region close to the shadow zone by interfering with the direct wave.

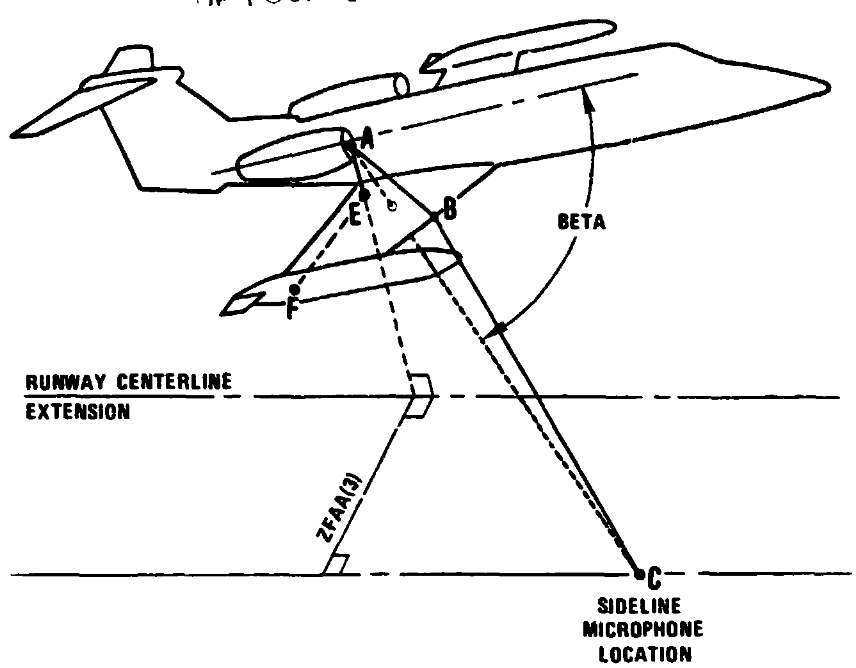

Figure 54. Wing Shielding Noise Reduction Computation Model.

The inlet noise reduction (NR) by wing shielding is determined for each 1/3-octave band frequency (f_i) at each 1/2-second time increment by

$$NR(f_i) = \begin{cases} 20 \log \dfrac{\sqrt{2\pi N}}{\tanh\sqrt{2\pi N}} + 5.0; & N > 0 \\ 20 \log \dfrac{\sqrt{2\pi |N|}}{\tan\sqrt{2\pi |N|}} + 5.0; & -0.2 < N < 0 \\ 0. & ; N < -0.2 \end{cases}$$

where N, the Fresnel number, is defined as

$$N = \pm \frac{2 f_i \delta}{c}$$

c = free stream speed of sound

f_i = frequency for each 1/3-octave band, hz

δ = difference in source-receiver path length between the direct and diffracted sound fields

$$\delta = \overline{AB} + \overline{BC} - \overline{AC} \quad \text{(for leading edge shielding)}$$

$$\text{or} \quad \overline{AF} + \overline{FC} - \overline{AC} \quad \text{(for wing-tip shielding)}$$

The model used for the calculation is shown in Figure 54. The user must input 3 engine-wing distances, depicted as $\overline{AE}$, $\overline{EB}$, and $\overline{EF}$ in Figure 54. WING determines whether the effective barrier is the wing leading edge or the wing tip. This can, and usually does, change along the flight profile at the sideline condition.

The sideline microphone is shown in Figure 54 at Position C, and the engine is located at Point A. Line $\overline{AE}$ represents the height of the engine centerline from the wing. Line $\overline{AB}$ connects the fan centerline to the edge of the wing. Line $\overline{AC}$ shows the relative position of the fan with respect to the microphone. Line $\overline{EF}$ represents the distance between the projection of $\overline{AE}$ on the wing and the wing tip.

The maximum noise reduction for wing shielding for any 1/3-octave band is set at 24.5 dB as a practical limit.

<u>Reflecting Ground Plane</u> - In lieu of adding a constant 3.0 dB at each 1/3-octave frequency for each noise source due to the presence of a reflecting plane, subroutine GNDREF calculates the ground-reflection correction for each 1/3-octave frequency, based on the path-length difference between the direct and reflected acoustic wave (due to the presence of the reflecting ground plane).

The method used is based on the methods contained in ref. 18 as modified to agree with experimental data. The ground-reflection correction is calculated for each 1/3-octave frequency at each 0.5-second time interval. The correction is added to the free-field noise prediction for each noise source.

The correction, ΔdB, that is added to the free-field level is found from

$$\Delta dB = 10\ \mathrm{LOG}_{10} \left\{ 1 + (Q \cdot Q_{SG}/Z)^2 + 2\ (Q \cdot Q_{SG} \cdot Q_{SJ}/Z)\ \frac{\sin(0.72571\ \Delta r/\lambda)}{0.72571\ \Delta r/\lambda} \cdot \cos\ (6.32496\ \Delta r/\lambda - \delta) \right\}$$

where

λ = the wave length

δ = phase of reflection coefficient

Δr = the path-length difference between the reflected and direct wave

Z = the ratio of the path length of the reflected wave to the path-length of the direct wave

Q = the reflection coefficient, computed as a function of a locally reacting surface impedance model typical of an acoustically absorbing ground plane.

The quantity Q_{SJ} is an energy-scattering coefficient to account for the incoherence of the numerous turbulent eddies that generate jet noise in the boundary layer between the jet and the quiescent surrounding atmosphere. The quantity Q_{SG} is an energy-scattering coefficient for surface roughness or "waviness." This

parameter becomes important for frequencies where the wave length is approximately equal to the size of surface irregularities. The inclusion of Q_{SG} and Q_{SJ} corrections is a user option.

Figure 55 shows the values of Q_{SJ} and Q_{SG} as a function of frequency that are used in the ground reflection correction calculation.

<u>Extra-Ground-Attenuation (EGA)</u> - Extra-ground attenuation, ΔdB, for each 1/3-octave frequency at each 0.5 second is calculated in subroutine EGAC, taken from a NASA program, ref. 19. The correction is based on the distance from the source to the receiver, and the elevation angle between the source and receiver and the ground plane. Corrections are set to zero for elevation angles above 45 degrees. The extra-ground-attenuation corrections are subtracted from the predicted levels for each source at the sideline condition only.

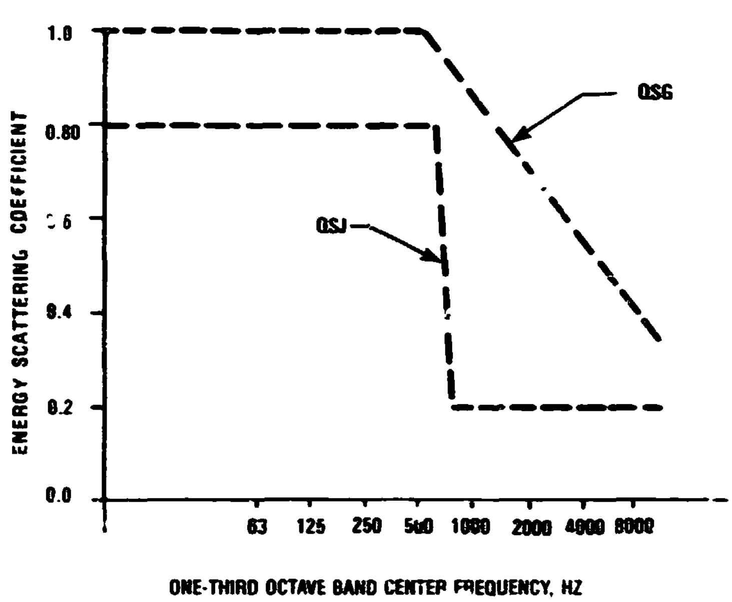

Figure 55. Incoherence (QSJ) and Ground (QSG) Energy Scattering Coefficients Used for Ground Reflection Correction Calculation.

For all time increments along the flight path, the values of L_{PN} and L_{TPN} for each source and the aircraft total are computed in subroutines PERNL and TONCOR and retained. Values of maximum L_{PN}, L_{TPN}, L_P and L_{PA} for all sources and the minimum slant distance are continuously updated throughout the flight path and retained along with their respective time interval indices. The user has the option to stop the flight path analysis when the L_{TPN} for the total noise is 10 dB below the maximum L_{TPN} found.

When the flight path analysis has been completed, the total time history of L_{PN} and L_{TPN} is analyzed for each source to calculate the duration times and corrections associated with the maximum L_{TPN}. The L_{EPN} for each source and the total noise is then computed. The calculation procedures adhere to the prescribed methods of FAR 36, Appendix B, except that the L_{TPN} limit of 90 dB in Paragraph B.36.9.F is implemented as a user option.

3.6 Output Module

The output module consists of two subroutines: PRINT and PROUT.

Subroutine PRINT is the basic printer output module. It allows the user to specify one of 3 levels of output detail: summary, intermediate, and full.

The summary output includes the user-input and defaulted-input data and a one-page summary of the final computed values of L_{EPN} and maximum L_{TPN}, L_{PN}, L_P and L_{PA} for each source and the total aircraft.

The intermediate printout includes the summary plus a listing of the flight profile, a summary of noise levels at the minimum aircraft-observer slant distance, and spectra of the static noise sources.

The full printout includes the intermediate printout plus a detailed noise level summary, by source, at every 0.5-second interval along the profile.

The variable that controls the output option is IPOUT in NAMELIST &CONT.

Subroutine PROUT generates a one-page listing of the static noise spectra for each source at all angles from frequencies of 20 Hz to 20,000 Hz. It also tabulates the overall noise levels and the computed power level. PROUT is controlled through the variable IPOUT.

3.7 Utility Subroutines

- Subroutine SUMSPL

  SUMSPL computes the overall L_P and L_{PA} of an input spectrum from 20 Hz to 20,000 Hz. An option restricts the frequency spectrum to a range from 50 Hz to 10,000 Hz.

- Subroutine POWER

  POWER computes the spectral and overall L_W from 20 Hz to 20,000 Hz for a free-field (no reflecting planes) input noise spectra. It is used to compute the sound power levels for each static noise source.

- Subroutine GOLD1

  GOLD1 initiates a one-dimensional golden section search for the maximum sideline L_{EPN}. Iterations are performed on the sideline microphone location until its location for maximum L_{EPN} is determined within a user-specified range tolerance, defaulted to 30.5 meters (100 ft). GOLD1 consists of computer code found in ref. 20.

- **Subroutines TERP and SERCH**

  TERP and SERCH are used to linearly interpolate two- and three-dimensional data arrays. They are NASA routines taken from ref. 19.

- **Subroutine PERNL**

  PERNL calculates the perceived noise level, L_{PN}, for an input spectra from 50 Hz to 10,000 Hz. It follows the calculation procedures of FAR 36, Appendix B, and is based on material from ref. 19.

- **Subroutine TONCOR**

  TONCOR computes the tone correction to be applied to the L_{PN} of a noise spectra and is based on ref. 19. It includes an option, IPSEUD, to exclude any tone corrections below 1000 Hz. The tone correction is used to eliminate any spurious tones due to ground reflections. It should not be used when a propeller source is included. TONCOR adheres to the procedures of FAR 36, Appendix B.

- **Subroutine FAALIM**

  FAALIM computes the FAR 36 noise certification effective perceived noise level limits according to the certification condition specified (IFAA), the aircraft maximum takeoff gross weight (WGMAX), the applicable FAR 36 noise stage (ISTAG), and the type of aircraft engine (NTYE).

  The noise limit value is printed on the summary output so that the user can compare predicted noise levels with the applicable FAR 36 certification limit.

o **Subroutine UNITS**

UNITS converts input data units from the SI system to the English system prior to performing calculations when the user specifies SI units for the ISI option. In addition, UNITS converts certain default values to SI units at program initialization to prevent those values from being converted incorrectly to English units after the input data has been read.

o **Subroutine PRPCOR**

PRPCOR calculates a performance correction to turboprop level flyover noise levels as required by FAR 36, Appendix F. Input data that must be supplied to PRPCOR includes the distance from brake release to clear a 15.2-meter (50-ft) obstacle, the certified best rate of climb, and the aircraft velocity for best rate of climb. Unless all three values are specified, the performance corrections will not be made.

SECTION IV

4.0 PROGRAM FUNCTIONAL FLOWCHART

A functional flowchart depicting the major subroutine interfaces is presented in Figure 56.

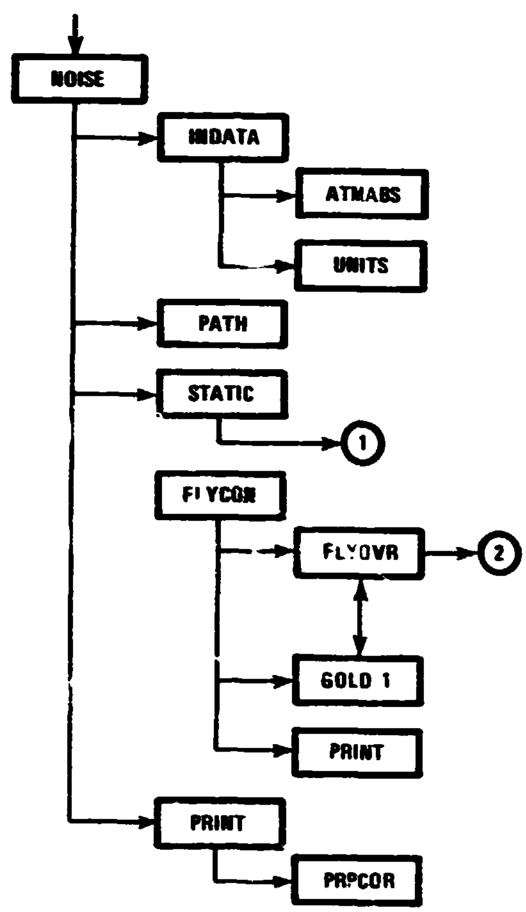

Figure 56(a). Flowchart of Major Subroutine Interfaces.

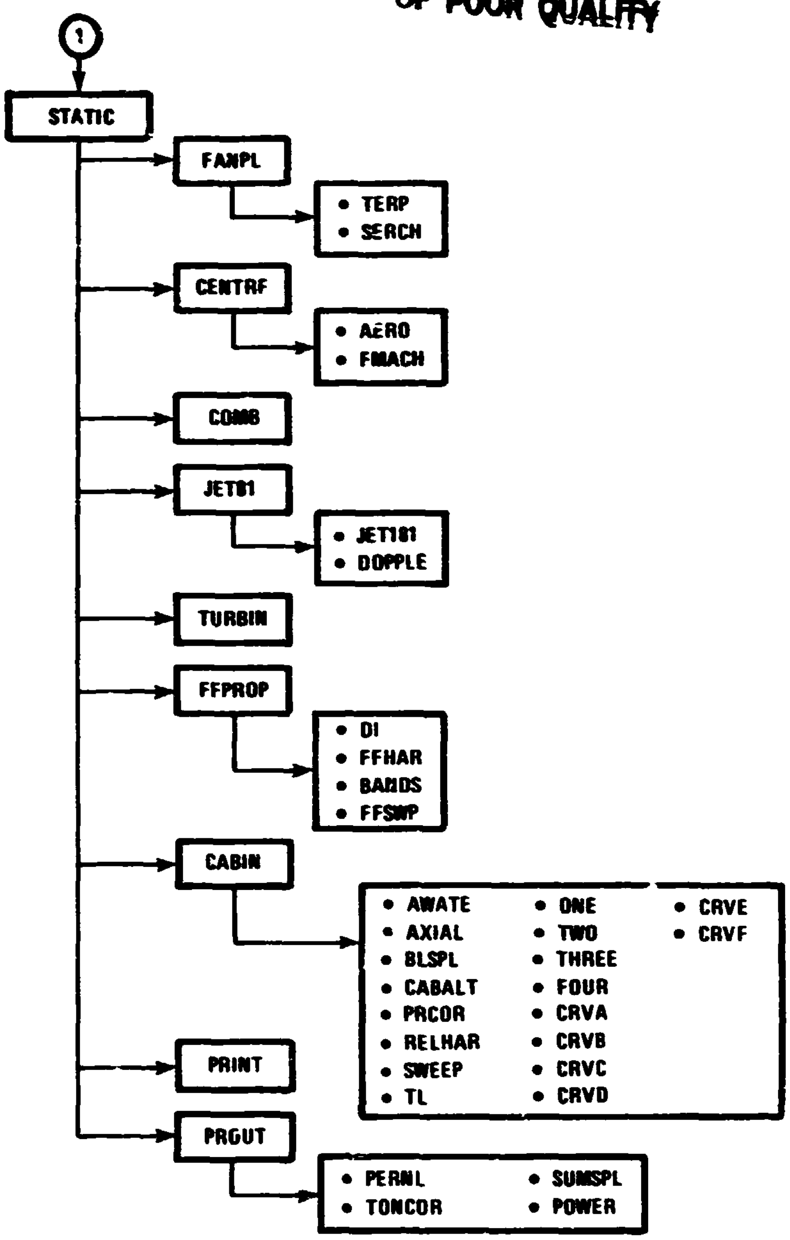

Figure 56(b)

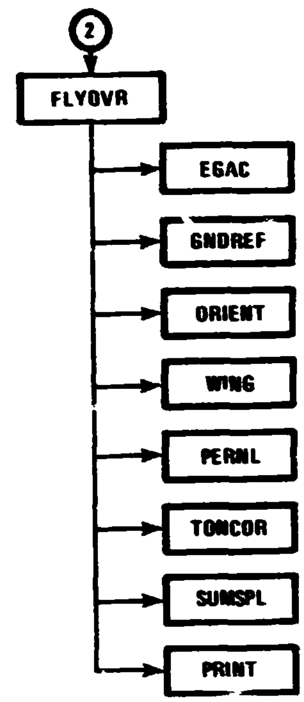

Figure 56(c)

Figure 56(b) and (c). Flowchart of Major Subroutine Interfaces.

SECTION V

5.0 PROGRAM VERIFICATION

The turbofan/turbojet option of program NOISE was verified by predicting the FAR 36 takeoff, approach, and sideline certification noise levels for a Garrett TFE731-2 turbofan-powered Lear 36 executive jet aircraft. The output of NOISE for these predicted conditions is presented in Appendix A, Sample Test Cases.

A comparison of the NOISE-predicted levels with the certification data documented in FAA Advisory Circular 36-1B, ref. 22, is presented below.

FAA Certification Condition	Effective Perceived Noise Level, EPNdB	
	NOISE Prediction	Certified (FAA, Reference 22)
Approach	91.2	92.2
Takeoff	85.2	84.0
Sideline	88.1	86.9

The predicted levels at all three FAA certification conditions demonstrate a level of accuracy that far exceeds the tolerance requirements of 5 EPNdB.

The turboprop option for a level flyover was verified with a Mitsubishi MU2J business aircraft powered by two Garrett TPE331-6-251M engines. The measured level for this aircraft during a 1000-foot level flyover is 76.8 dB(A). The predicted flyover noise is 78.1 dB(A), well within the 5 dB(A) tolerance requirements. The computer generated output for this condition is presented in Appendix A.

The cabin noise option was verified with a prediction of noise levels in an Aero Commander 680E and a Gulfstream Commander 1000. Measured levels in the 680E aircraft range from 97 to 101 dB(A) with an average of 99 dB(A) in the center of the cabin. The predicted level was 98.7 dB(A), which agrees with the average measured level. The predicted level of 93.2 dB(A) at the center of the cabin for the Commander 1000 was also in good agreement with measured levels, which range from 90 to 92 dB(A). The computer-generated output for the 680E prediction is presented in Appendix A.

SECTION VI

6.0 USER'S MANUAL

6.1 Introduction

Program NOISE is the executive control program for the computer prediction of FAR 36 certification noise levels for general aviation turbofan, turbojet, and turboprop aircraft. By calling five major modules, NOISE effectively controls all program subroutines.

NOISE is a companion preliminary design tool to the NASA General Aviation Synthesis Program, GASP. As such, it should provide FAR 36 noise level estimates to within 5 EPNdB. Seven noise prediction options are available:

FAR 36 Approach
FAR 36 Takeoff
FAR 36 Sideline
FAR 36 Level Flyover
Static components at takeoff operating point
Static components at approach operating point
Cabin noise

Noise predictions are made on an engine component basis and summed to obtain total engine/propeller flyover noise levels. The following components and noise sources can be specified by the user for inclusion in the noise prediction study:

Fan
Axial Compressor
Centrifugal Compressor
Combustor
Jet

Axial Turbine
Radial Turbine
Propeller

6.2 NAMELIST Organization

NOISE contains 12 NAMELIST blocks for program input. The NAMELISTS are functionally organized so that the input of their variables follows the flow of the program logic. A list of the NAMELIST groups and their functional descriptions is tabulated below:

NAMELIST	Description
&CONT	Major control variables
&ENV	Environmental (ambient) conditions
&SYS	Engine/aircraft descriptors
&FPRO	Flight profile generation variables
&FAN	Fan/axial compressor noise prediction variables
&CENT	Centrifugal compressor noise prediciton variables
&BURNER	Combustor noise prediction variables
&JET	Jet noise prediction variables
&TURB	Turbine noise prediction variables
&PROP	Propeller noise prediction variables
&FLY	Flyover noise control variables
&CAB	Cabin noise prediction variables

The variables for each of these NAMELIST blocks are presented in Tables I through XII. Default values are given, and a description of each variable along with any necessary instructions is provided. For example, in NAMELIST group &CONT, Table I, the major control variables are IFAA, IPOUT, ISTAGE, ICAB and ISI.

TABLE I

NAMELIST GROUP: CONT

VARIABLE	DEFAULT	DESCRIPTION
IFAA	0	Master program control variable: = 0, stop program = 1, FAR 36 approach = 2, FAR 36 takeoff = 3, FAR 36 sideline = 4, FAR 36 level flyover = 5, static engine predictions, takeoff = 6, static engine predictions, approach = 7, cabin noise predictions only (If IFAA ≥8, program will abort)
IPOUT	1	Output detail level option: = 1, Summary; input and FAA certification levels = 2, Intermediate; summary plus minimum slant distance, flight profile, and static engine spectra = 3, Full; intermediate plus detailed fly-over source analysis at all 0.5-second intervals
ISTAGE	3	FAR 36 stage limit (1, 2, or 3) to be applied. All new aircraft types are certified to Stage 3 limits
ICAB	0	Cabin noise prediction option = 0, No prediction = 1, Cabin noise predicted (NAMELIST &CAB must be input)
ISI	0	System of units option for input data = 0, English units = 1, SI units

TABLE II

NAMELIST GROUP: ENV

VARIABLE	DEFAULT	DESCRIPTION
TAMB	536.69	Ambient temperature at source, °R
PAMB	2116.22	Ambient pressure at source, psf
RH	70.0	Relative humidity, percent
DIST	100.0	Distance from engine at which static predictions are made, ft.
ANGLE (array of length 16)	10-160	Angles from engine inlet at which static noise predictions are made, degrees. (Default is 10 degrees to 160 degrees in 10-degree increments).
NLOC	16	Number of angles in ANGLE array. (Maximum number is 16)

TABLE III

NAMELIST GROUP: SYS

VARIABLE	DEFAULT	DESCRIPTION
NTYE	0	Aircraft engine type: = 0, defaults to turbofan with warning message = 1, Turbofan = 2, Turbojet = 3, Turboprop = 4, Propeller noise source only; ICOMP is not to be specified
ICOMP (array of length 6)		Array of engine components to be used as noise sources: = 0, end of sources = 1, Fan = 2, Axial Compressor = 3, Centrifugal Compressor = 4, Combustor = 5, Jet = 6, Axial Turbine = 7, Radial Turbine = 8, Propeller The ICOMP array must be filled in the order in which the user inputs the individual component NAMELISTS. A maximum of 6 sources may be specified.
ENP	2.0	No. of engines on aircraft
LOCENG	1	Engine location on aircraft = 1, fuselage-mounted = 2, wing-mounted
XL	5.5	Distance from engine inlet to wing leading edge, ft. See Section 3.5.2(f) of Final Report for further explanation.
YL	2.6	Distance from engine inlet centerline to top wing surface, ft.

TABLE III (Cont'd)

NAMELIST GROUP: SYS (Continued)

VARIABLE	DEFAULT	DESCRIPTION
ZL	16.7	Distance from engine inlet centerline to wing tip, ft. (XL, YL and ZL are used for wing-shielding corrections and are applied only to the inlet noise contributions of fuselage-mounted engines.
IPHASE	0	Phase synchronization of multiengine installations: = 0, Engines in phase = 1, Engines out of phase
ANENGI	0.	Angle between engine inlet and aircarft centerlines, degrees. Positive if above aircraft centerline.
ANENGE	0.	Angle between engine exhaust and aircraft centerlines, degrees. Positive if below aircraft centerline.
WGMAX	0.	Aircraft maximum takeoff gross weight, lb.
VEL	0.	Aircraft flight velocity, fps (Computed from AMACH if VEL = 0.)
AMACH	0.	Aircraft Mach No. (Computed from VEL if AMACH = 0.) Note: Either VEL or AMACH must be user-specified if flyover noise is requested; otherwise program will abort.)
IDOP	1	Option to Doppler-shift noise source frequency spectra for aircraft motion relative to observer = 0, No Doppler shift = 1, Doppler shift

C-2

TABLE IV

NAMELIST GROUP: FPRO

VARIABLE	DEFAULT	DESCRIPTION
IDPRO	0	Acoustic flight profile generation option = 0, Straight line approximation = 1, User input profile If IDPRO = 1, the user must input the flight profile on Logical Unit 55 according to the following fixed-field format (6E12.5): Columns — Variable 1-12 Time, sec. 13-24 Range from brake release, ft. 25-36 Altitude above runway, ft. 37-48 Aircraft velocity, fps 49-60 Aircraft angle of attack, degrees 61-72 Aircraft climb angle, degrees A series of the above-described records must be entered in ascending time intervals. Linear interpolation will be performed between intervals. The maximum overall time interval is 249.5 seconds. Only if IDPRO = 0 are the remaining NAMELIST variables entered.
FLTANG	Takeoff: 11.0 (fans, jets) 5.0 (props)	Constant climb angle for takeoff and sideline, or constant glideslope angle for approach, degrees
	Approach 3.0	The approach default conforms to FAR 36 procedures.

TABLE IV (Cont'd)

NAMELIST GROUP: FPRO (Continued)

VARIABLE	DEFAULT	DESCRIPTION
ANGAFT	Takeoff: 7.2 (fans, jets) 10.0 (props) Approach: 4.0 Level Flyover: 0.0	Constant aircraft angle of attack, degrees
TOROLL	Fans, jets: 4500. Props: 2300.	Distance along runway from brake release to aircraft rotation on takeoff, ft.
APDIST	10685.0	Initial aircraft approach range from touch-down, ft. (Default conforms to FAR 36 procedures.)
XALT	1000.0	Aircraft altitude over observer for a level flyover, ft. (Default conforms to FAR 36 procedures.)
ALTJT	984.0	Aircraft altitude at sideline condition estimated for aircraft location at point of maximum sideline L_{EPN}. This variable is used only when IDPRO = 1.

TABLE V

NAMELIST GROUP: FAN (FOR FANS AND AXIAL COMPRESSORS)

VARIABLE	DEFAULT	DESCRIPTION
IGV	0	Inlet guide vane: = 0, no IGV's, = 1, fan has inlet guide vanes
IFD	0	Inlet flight mode option: IFD = 0, flight mode IFD = 1, static and ground roll mode
NH	8	Number of blade passage frequency harmonics to be calculated
NSTG	1	Number of fan stages
NBF	0	Number of first-stage fan blades
NVAN	0	Number of first-stage stator vanes
RSS	100.	Rotor-stator axial spacing/axial chord x 100, percent
WAFAN	0.	Total mass flow at fan inlet, lb/sec
RPM	0.	Fan physical speed, rpm
DELT	0.	Total temperature rise across fan, °R
FPR	0.	Fan pressure ratio, must specify if DELT = 0.
FANDIA	0.	Fan tip diameter, ft.
FANHUB	0.	Fan hub diameter, ft.
TIPMD	0.	Fan design point relative tip Mach number
TIPM	0.	Fan relative tip Mach No., computed if TIPM = 0.
FANEFF	0.	Fan efficiency, must specify if DELT = 0.
NBF2	0	Number of fan blades, second stage
NVAN2	0	Number of stator vanes, second stage

TABLE V (Cont'd)

NAMELIST GROUP: FAN (FOR FANS AND AXIAL COMPRESSORS) (Continued)

VARIABLE	DEFAULT	DESCRIPTION
FAND2	0.	Fan tip diameter, second stage, ft.
TIPMD2	0.	Fan second stage design point relative Mach number
TIPM2	0.	Fan second stage relative tip Mach number
RSS2	100.	Second stage rotor-stator spacing constant
PRAT	0.	Ratio of pressure ratios between stages, $P_3/P_2 \div P_2/P_1$
TRAT	0.	Ratio of temperature rises between stages, $\left(T_3-T_2\right)/\left(T_2-T_1\right)$
FANEF2	0.	Second stage fan efficiency
IBUZ	0	= 0, Revised combination tone noise calculation = 1, Original NASA combination tone noise calculation
ITONE	0	= 0, Revised discrete tone calculation = 1, Original NASA discrete tone calculation
CAEF	40.	Dynamic amplification factor

TABLE VI

NAMELIST GROUP: CENT

VARIABLE	DEFAULT	DESCRIPTION
RPMC	0.	Compressor physical rotational speed at operating condition, rpm
RPMCD	0.	Compressor physical rotational speed at design point condition, rpm
T_1	0.	Compressor inlet temperature, °R
P_1	0.	Compressor inlet pressure, psf
DELTC	0.	Compressor total temperature rise ratio, $\Delta T/T$
CMASS	0.	Compressor mass flow at operating condition, lb/sec
CMASSD	0.	Compressor mass flow at design point, lb/sec
DTLE	0.	Inducer inlet tip diameter, ft
DHLE	0.	Inducer inlet hub diameter, ft
NBC	0	No. of compressor blades
CAECN	40.	Dynamic amplification factor

TABLE VII

NAMELIST GROUP: BURNER

VARIABLE	DEFAULT	DESCRIPTION
WACOMB	0.	Combustor mass flow, lb/sec
T_3	0.	Combustor inlet temperature, °R
T_4	0.	Turbine inlet total temperature, °R
P_3	0.	Combustor inlet total pressure, psf
CAEC	20.	Dynamic amplification factor See Final Report, Section 3.4.1(b)

TABLE VIII

NAMELIST GROUP: JET

VARIABLE	DEFAULT	DESCRIPTION
VJ	0.	Fully expanded primary jet velocity, fps
TJ	0.	Primary jet total temperature, °R
GAMJ	0.	Primary jet specific heat ratio. Will be calculated from TJ if not input.
RHOJ	0.	Fully expanded jet density, slug/cubic ft Will be calculated if not input.
DJ	0.	Primary jet outer diameter, ft Use throat for convergent-divergent nozzle
HJ	0.	Primary jet annular height, ft Must be at least 0.5 DJ for a circular jet
AJ	0.	Fully-expanded jet area, sq. ft. Will be calculated if not input
VJ2	0.	Fully-expanded secondary jet velocity, fps
TJ2	0.	Secondary jet total temperature, °R
GAMJ2	0.	Secondary jet specific heat ratio
DJ2	0.	Secondary jet outer diameter, ft
HJ2	0.	Secondary jet annular height, ft
EL2	0.	Axial distance from secondary jet exit plane to primary jet exit plane, ft
ALFAJ	0.	Angle between jet velocity and nozzle forward velocity, degrees. Will be internally calculated if flyover condition is specified.
PHIJ	0.	Small angle defining sideline, degrees. Used only for sideline and is internally calculated if sideline flyover (IFAA=3) is specified and PHIJ is 0.0 at input.

TABLE VIII (Cont'd)

NAMELIST GROUP: JET (Continued)

VARIABLE	DEFAULT	DESCRIPTION
V0	0.	Nozzle (aircraft) forward velocity, fps. If VEL is specified in &SYS, V0 is set to VEL.
INVOPT	0	Calculation option for inverted jets only (VJ2 > VJ): = 0, merged and premerged summed = 1, merged only = -1, premerged only

TABLE IX

NAMELIST GROUP: TURB

VARIABLE	DEFAULT	DESCRIPTION
RPMT	0.	Turbine physical rotational speed, rpm
DT	0.	Axial turbine tip diameter, radial turbine exducer exit tip diameter, ft
DH	0.	Axial turbine hub diameter, radial turbine exducer exit hub diameter, ft
ACNZ	0.	Turbine exit flow area, square ft will be computed from DT and DH if defaulted to 0. Must be input if DH not specified.
NBT	0	Number of turbine rotor blades
DTOT	0.	Nondimensional isentropic temperature drop for the entire turbine section. Required input if PRTS = 0.
PRTS	0.	Turbine section pressure ratio, total-to-static. Required input if DTOT = 0.
GAM_T	1.333	Turbine specific heat ratio
CAET	40.	Dynamic amplification factor. See Final Report, Section 3.4.1(b).

TABLE X

NAMELIST GROUP: PROP

VARIABLE	DEFAULT	DESCRIPTION
DIAP	1.	Propeller diameter, ft.
NBP	1	No. of propeller blades. Set NBP to its negative value to indicate a swept-blade propeller
SHP	1.	Engine shaft horsepower absorbed by the propeller, hp
RPMP	1.	Propeller rotational speed, rpm
CAEP	40.	Dynamic amplification factor. See Final Report, Section 3.4.1(b).
BLTH	0.0292*	Propeller blade thickness at 70-percent span.
BLCH	.65*	Blade chord at 70-percent span.
BLAK	5.*	Propeller blade angle of attack at 70 per-cent-span.
BLAREA	6.174*	Total blade area on one side of all blades, ft^2

*Default values correspond to a Hartzell T10282, 102 inch diameter, 3-bladed propeller.

TABLE XI

NAMELIST GROUP: FLY

VARIABLE	DEFAULT	DESCRIPTION
XFAA (array)		Range locations of measuring stations (microphones) for FAR 36 certification, ft.
(1)	7516.	Approach
(2)	21325.	Takeoff
(3)	21325.	Sideline (initial right-hand default boundary for iteration)
(4)	0.	Level flyover
YFAA (array)		Height of measuring stations, ft
(1)	4.	Approach
(2)	4.	Takeoff
(3)	4.	Sideline
(4)	4.	Level flyover
ZFAA (array)		Sideline distance of measuring stations, ft
(1)	0.	Approach
(2)	0.	Takeoff
(3)	1476.	Sideline
(4)	0.	Level flyover
XLSIDE	TOROLL	Initial left-side boundary for sideline iteration.
XRSIDE	XFAA(3)	Initial right-side boundary for sideline iteration.
IQS	1	Option to include energy-scattering coefficients in ground-reflection calculations. See Final Report, Section 3.5.2(e). = 0, do not include coefficients = 1, include coefficients
IDUR	1	Option to stop flyover analysis when total engine L_{TPN} is 10 dB down from its maximum value = 0, do not stop at 10 dB downpoint = 1, stop at 10 dB downpoint

TABLE XI (Cont'd)

NAMELIST GROUP: FLY (Continued)

VARIABLE	DEFAULT	DESCRIPTION
ICUT	0	Option to limit duration interval for L_{EPN} calculation to tone-corrected noise levels above 90 dB, per FAR 36, Appendix B, [36.8.5(n)] = 0, do not impose limit = 1, impose limit
IPSEUD	1	Option to eliminate tone correction calculations for L_{PN} for frequencies below 1000 Hz. This option should not be used for propeller cases since propeller noise harmonics occur below 1000 Hz. = 0, do not impose option = 1, impose option
KGOLD	0	Option to print convergence monitor in subroutine GOLD1 for sideline iterations. = 0, do not print = 1, print
XTOL	100.	Convergence tolerance distance for sideline microphone location in determining sideline location of maximum L_{EPN}, ft. The number of required L_{EPN} iterations decreases as XTOL is increased.
IWING	0	Wing shielding option; valid only for turbofan/turbojet aircraft with fuselage-mounted engines. = 0, impose option = 1, do not impose option

TABLE XI (Cont'd)

NAMELIST GROUP: FLY (Continued)

VARIABLE	DEFAULT	DESCRIPTION
		The following are used only for a turboprop airplane in a level 1000 ft flyover. They are used for a performance correction to the predicted levels.
D50	Single engine: 2000. Multi-engine: 2700.	Takeoff distance to 50-ft altitude at maximum certified takeoff weight, ft.
RC	0.	Certified best rate of climb, fps
VY	0.	Airplane speed for best rate of climb, fps (If RC = 0 or VY = 0, no performance correction is made.)

TABLE XII

NAMELIST GROUP: CAB

VARIABLE	DEFAULT	DESCRIPTION
DIAP	1.	Propeller diameter, ft
NBP	1	No. of propeller blades. Set NBP to its negative value to indicate a swept-blade propeller.
SHP	1.	Engine shaft horsepower absorbed by the propeller, hp
RPMP	1.	Propeller rotational speed, rpm
ALTIT	7500.	Aircraft altitude for cabin noise, ft.
TC	1.	Radial propeller tip-to-fuselage clearance, ft.
FAD	0.	Forward or aft distance, relative to plane of propeller, where noise calculations are made, ft.
PRES	0.	Cabin pressurization, psf
DAFT	10.	Fuselage distance aft of aircraft nose, where boundary layer noise is calculated, ft.

6.3 Data Input Instructions

The inclusion of each NAMELIST in the input file is dependent upon the value of the master control variable, IFAA, in NAMELIST &CONT. Table XIII presents a listing of required NAMELISTS for each value of IFAA, and the order in which they must be input.

In addition, noise component NAMELISTS must be input, in type and order, according to the user-input values specified for the engine component array, ICOMP, in NAMELIST &SYS.

Failure to include all required NAMELISTS in their proper order will result in a program abort.

All NAMELISTS must be entered according to the following format:

(a) Each NAMELIST block must start with an & in Column 2, followed immediately with the NAMELIST name.

(b) A blank must occur in the column following the NAMELIST name.

(c) Data is entered in the remaining record columns according to the format: Variable Name = value. Commas must separate each variable set.

Array values are input in array index order such as shown in the following examples:

(i) ..., ICOMP = 1,4,5,6, NTYE =1, ...

(ii) ..., XFAA(3) = 10000., ...

TABLE XIII. ORDER OF INPUT TO NOISE

A. Flyover Noise Studies ($1 \le IFAA \le 4$)

```
&CONT
TITLE CARD
&ENV
&SYS
&FPRO
(Engine/Propeller Component NAMELISTS)  **
     &FAN
     &CENT
     &BURNER
     &JET
     &TURB
     &PROP
&FLY
&CAB (*)
&CONT IFAA = 0 &END (Program Stop)
```

B. Static Component Noise Studies ($5 \le IFAA \le 6$)

```
&CONT
TITLE CARD
&ENV
&SYS
(Engine/Propeller Component NAMELISTS)  **
     &FAN
     &CENT
     &BURNER
     &JET
     &TURB
     &PROP
&CAB (*)
&CONT IFAA = 0 &END (Program Stop)
```

C. Cabin Noise Studies Only (IFAA = 7)

```
&CONT
TITLE CARD
&SYS
&CAB
&CONT IFAA = 0 &END (Program Stop)
```

*Include &CAB only when ICAB = 1 in NAMELIST &CONT

**Enter components in the order specified in array ICOMP in NAME-LIST &SYS. Enter only those components specified.

In (i) the first four locations of ICOMP are filled with "1", "4", "5", and "6". Locations 5 and 6 retain their default values of 0. In (ii) only the third location of XFAA has been changed from the default value.

More than one card may be used for a NAMELIST block. A comma must follow the last variable set on an intermediate or initial card of a multicard set. Data on all cards must start in Column 2.

(d) A space followed by &END after the last variable set in a block indicates the end of the block. The "&END" alternatively may be entered, starting in Column 2, on the card following the last variable set.

(e) If default values are used for all variables in a NAMELIST, the NAMELIST card must still be entered. An example is as follows:

&FPRO_&END

Typical input data streams are shown in the example in Figure 57. Although the program logic is capable of multicase execution, default values are set in DATA statements of BLOCK DATA subroutines, and the user must assure himself that succeeding cases are properly initialized through user input. It is highly recommended that only one case be input per execution.

If the user selects the external flight profile option in NAMELIST &FPRO, he must input the profile on Logical Unit 55 according to the format described in Table V.

The input file used in the program READ statements is LIN. It is set to logical unit 5 in labeled COMMON/IO/ in BLOCK DATA.

```
&CONT IFAA=2,IPOUT=3,ISTAG=3 &END
TFE731/LEAR36 TAKEOFF SIMULATION FLYOVER NOISE PREDICTION
 &ENV &END
 &SYS NTYE=1,ICOMP=1,4,5,6,VEL=288.2,WGMAX=17000.,
 ENP=2.,LOCENG=1 &END
 &FPRO FLTANG=10.97,TCRCLL=4500.,ANGAPT=7.2,
 &END
 &FAN IFO=0,NBL=30,NVAN=109,RSS=200.,FANDIA=2.319,FANHUB=1.125,TIPMD=1.48,
 WAFAN=104.82,RPM=11101.,DELT=80.7,
 &END
 &BURNER WACOMB=28.854,T3=1269.,T4=2287.4,P3=27995. &END
 &JET VJ=1909.,TJ=1427.,DJ=.9994,MJ=.5,VJ2=922.,TJ2=613.,
 DJ2=1.6292,MJ2=.3340,EL2=.78 &END
 &TURB RPMT=20076.,DT=1.266,DH=.745,BT=90.,ACNZ=.8237,DTOT=.45 &END
 &FLY XFAA(2)=21230.,IWING=0,IOUP=1 &END
 &CONT IFAA=0 &END
```

(a) Input Stream for a Takeoff Condition Prediction

```
 &CONT IFAA=5,IPOUT=3,ISTAG=3 &END
 TYPICAL BUSINESS JET TURBOFAN AT TAKEOFF STATIC THRUST POWER
 &ENV TAMB=536.69 &END
 &SYS NTYE=1,ICOMP=1,4,5,6,0,0,ENP=1.,LOCENG=2,XL=5.,YL=1.,ZL=15.,
 IPHASE=0,IDOP=0 &END
 &FAN IFO=1,NBF=28,NVAN=66,RSS=183.,FANDIA=1.749,FANHUB=.706,
 TIPMD=1.42,TIPM=1.355,
 WAFAN=68.01,RPM=13361.,DELT=81.1,
 ITONE=0,IBUZ=0,
 &END
 &BURNER WACOMB=17.18,T3=1001.,T4=2253.,P3=15235.2 &END
 &JET VJ=1057.,TJ=1566.,DJ=.8745,MJ=.43725,VJ2=931.,TJ2=621.4,
 DJ2=1.40189,MJ2=.2637,EL2=.78 &END
 &TURB RPMT=15361.,DT=1.282,DH=.816,ACNZ=.6,NBT=55,DTOT=.30181 &END
 &CONT IFAA=0 &END
```

(b) Input Stream for a Static Condition Prediction

```
  &CONT IFAA=7,IPOUT=3,ICAB=1 &END
 CABIN NOISE TEST CASE, AERO COMMANDER 680F
  &ENV TAMB=515. &END
  &SYS NTYE=4,ICOMP=8,LOCENG=2,VEL=270. &END
  &FPRO XALT=7500. &END
  &CAB DIAP=7.75,NBP=3,SHP=243.75,RPMP=1765.,ALTIT=7500.,TC=.375,
  FAD=0.,PRES=0.,DAFT=10. &END
  &CONT IFAA=0 &END
```

(c) Input Stream for a Cabin Noise Prediction

Figure 57. Sample Input Streams.

6.4 Input Data Requirements

All user input is through NAMELIST blocks except for the title card. Many variables are required only when certain options are invoked, and it is not necessary to define them when these options are not used.

NAMELIST input variable types adhere to standard FORTRAN conventions. Variable names which begin with the letters I through N represent integer values (no decimal point allowed). All other variable names represent real values (decimal point is used).

The master control variable, IFAA, specifies the noise condition to be used in the prediction study, and it controls all basic program logic paths.

The printer control option, IPOUT, allows the user to specify three levels of output: summary, intermediate, and full. Other major option flags available to the user include:

IDPRO - To select flight-profile generation method

IPHASE - To specify multiengine synchronization

IDOP - To include Doppler shift flight effects

IDUR - To stop the analysis when the engine L_{TPN} is 10 dB down from its maximum level

IQS - To include energy-scattering coefficients in ground-reflection calculations

IPSEUD - To exclude tone levels below 1000 Hz in L_{TPN} calculations

ICUT - To limit L_{EPN} duration correction interval to L_{TPN} levels above 90 dB

ISI - To establish the system of units for input data.

All options, except IFAA, are defaulted to values that would normally be specified by the user.

It is obvious that all input data must be consistent in physical units. Each input variable should be carefully reviewed prior to program execution. Input data errors are often readily apparent in the resulting program output. However, many times an incorrect input variable will result in only a small error in the numerical output. Unless the user is cognizant of the impact of every input variable on the output, these smaller errors can go undetected. Thus, it is imperative that the user carefully review and check all input data for its validity.

6.5 Diagnostic Messages

Error and warning messages are established throughout the program. They inform the user of the reason for a program abort due to input values or of certain key default values assumed due to a lack of sufficient input parameters. These messages are preceeded by "*****". A listing of these diagnostics is provided in Figure 53.

6.6 Output

The main output file used in the program WRITE statements is set as LOT. It is defaulted to logical unit 6 in labeled COMMON/IO/ in BLOCK DATA. In addition to the use of WRITE (LOT, xxx) statements, the diagnostic messages are repeated using PRINT xxx statements. This is done to facilitate the use of interactive execution of NOISE.

```
C
C   PROGRAM NOISE DIAGNOSTICS
C
C   ERROR,WARNING,AND INFORMATIVE MESSAGES
C   PRINTED ON OUTPUT DEVICE FOR INTERACTIVE USE AND
C   WRITTEN TO TAPE6 FOR PRINTER OUTPUT.
C
C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C   SUBROUTINE INDATA C
CCCCCCCCCCCCCCCCCCCCCCCC
    *****INVALID OPTION FLAG TO INDATA,IOPT=,I3,STOP
    *****(INDATA)PROGRAM STOP. IFAA=,I3
    *****(INDATA)VEL AND AMACH  NOT DEFINED. STOP.
    *****(INDATA)INVALID NTYE SET TO TURBOFAN (1)
    *****(INDATA)INVALID NTYE SET TO TURBOPROP (3)
    *****(INDATA)INVALID NO. OF ENGINES SET TO ,F3.1
    *****(INDATA)INVALID ENGINE LOCATION SET TO FUSELAGE (1
    *****(INDATA)ENGINE COMPONENTS NOT INPUT, SET TO ICOMP=,6I2
    *****(INDATA)VEL AND AMACH = 0..PROGRAM STOP.
    *****(INDATA)ICOMP(,I1,)=,I2, INVALID. PROGRAM STOP.
    *****(INDATA)NSOPC=0 FOR ENGINE TYPE ,I1,. PROGRAM STOP
CCCCCCCCCCCCCCCCCCCCCCCC
C   SUBROUTINE STATIC C
CCCCCCCCCCCCCCCCCCCCCCCC
    *****STATIC LEVELS AT AMBIENT CORRECTED TO FAA STD DAY
         CONDITIONS (77 DEG F, 70 PCT RH) FOR FLYOVER PREDICTIONS ONLY/
    *****WARNING,IKOMP(,I1,)=,I2,.INVALID.SUBROUTINE
         STATIC.PROGRAM WILL SET THIS COMPONENT SPL ARRAY TO 0.
CCCCCCCCCCCCCCCCCCCCCCCC
C   SUBROUTINE FLYCON C
CCCCCCCCCCCCCCCCCCCCCCCC
    *****SUBROUTINE FLYOVR NOT EXECUTED BECAUSE IFAA =,I3
CCCCCCCCCCCCCCCCCCCCCCC
C   SUBROUTINE PRINT C
CCCCCCCCCCCCCCCCCCCCCCC
    *****A STRAIGHT LINE PROFILE WILL BE COMPUTED FROM
         A COMBINATION OF THE ABOVE VARIABLES./
    *****A USER-INPUT FLIGHT PROFILE ON LOGICAL UNIT
         55 WILL BE USED FOR FLYOVER PREDICTIONS./
    *****THE FLIGHT PROFILE WILL BE TERMINATED WHEN THE
         OVERALL ENGINE PNLTC IS 10 DB BELOW ITS MAXIMUM VALUE (IDUR=1).
    ***** A DOPPLER FREQUENCY SHIFT WILL BE APPLIED
         TO ALL SOURCE STATIC SPECTRA AS A FUNCTION OF FLIGHT
         MACH NO. AND ANGLE FROM INLET.
    *****MAXIMUM TURBOPROP FLYOVER NOISE LEVEL
         IS ,F5.1, DB(A)/
    *****FLYOVER AIRCRAFT NOISE PREDICTION CASE COMPLETED*****
    *****ENGINES WERE ASSUMED TO BE OUT OF PHASE
         (IPHASE=1).
    *****90 DB LIMITATION IMPOSED ON DURATION
         CORRECTION PER FAA FAR36,B36.9.F, (ICUT=1).
    *****PSEUDOTONES BELOW 1000 HZ WERE ELIMINATED
         PER FAA FAR36, B36.5.M , (IPSEUD=1).
    *****FLYOVER NOISE LEVELS INCLUDE A DOPPLER SHIFT.
```

Figure 58. Program Noise Diagnostic Messages.

ORIGINAL PAGE IS
OF POOR QUALITY

```
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C                                                                        C
C   PROGRAM NOISE DIAGNOSTICS (CONTINUED)                                C
C                                                                        C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCCCCCCCCCCCCCCCCCCCCC
C   SUBROUTINE FLYOVR C
CCCCCCCCCCCCCCCCCCCCCC
   *****AIRCRAFT ALTITUDE IS NEGATIVE.STOP PROFILE AND
       CALCULATE EPNLS
   *****DURATION INTERVAL DECREASED FOR,A4,BECAUSE 10 DB DOWN
       CRITERIA WAS LIMITED TO 90 DB (PNLTC) PER FAR36.
   *****MAX PNLT AT FIRST INTERVAL FOR ,A4,.EPNL APPROX.
   *****MAX PNLT AT LAST INTERVAL FOR ,A4,.EPNL APPROX.
   *****PROFILE END REACHED BEFORE 10 DB DOWN FROM MAX PNL
       TC FOR ,A4,.EPNL APPROX.
CCCCCCCCCCCCCCCCCCCCCC
C   SUBROUTINE GOLD1 C
CCCCCCCCCCCCCCCCCCCCCC
   *****ERROR MESSAGE SUBROUTINE GOLD1*****,/,
            K,,I15, IS NOT 0 OR 1
   *****ERROR MESSAGE SUBROUTINE GOLD1*****,/,
            XL,,E15.7,NOT SMALLER THAN XR,,E15.7
   *****ERROR MESSAGE SUBROUTINE GOLD1*****,/,
            F,,E15.7, DOES NOT LIE BETWEEN C. AND 1.
CCCCCCCCCCCCCCCCCCCCCC
C   SUBROUTINE PERNL C
CCCCCCCCCCCCCCCCCCCCCC
   *****WARNING...BAND,I3, SPL OF F5.1, DB EXCEEDS
       MAXIMUM VALID PNL VALUE OF 150...SUBROUTINE PERNL.
CCCCCCCCCCCCCCCCCCCCCC
C   SUBROUTINE JET91 C
CCCCCCCCCCCCCCCCCCCCCC
   *****AREA RATIO PARAMETER BEYOND FIG. 12  NO FREQUENCY
       PERFORMED IN JET PREDICTION.
CCCCCCCCCCCCCCCCCC
C FUNCTION FMACH C
CCCCCCCCCCCCCCCCCC
   *****(FMACH) MACH NO DID NOT CONVERGE IN 50
       ITERATIONS FOR CENTRIFUGAL COMPRESSOR./
```

Figure 58. Program Noise Diagnostic Messages (Cont'd)

Proper allocation of resources for both output files should be established in the job control language procedures at the user's installation.

Three printer output options, through the variable IPOUT, are available to the user: summary, intermediate and full.

Sample output of the full (IPOUT=3) output option is presented in Appendix A.

SECTION VII

7.0 CONCLUSIONS AND RECOMMENDATIONS

Program NOISE meets, and exceeds, the major contract Task II objective of predicting turbofan- and turboprop-powered general aviation aircraft noise levels within a 5 dB level of accuracy at FAR 36 certification conditions. As such, it is capable of being used for preliminary design aircraft system studies.

Predictions for a typical turbofan-powered business aircraft were demonstrated to be within 1.2 EPNdB of FAA certified levels at all FAR 36 certification conditions. Level flyover predictions for a typical turboprop-powered business aircraft were demonstrated to be within 1.3 dB(A) of measured test data. The accuracy of near-field and cabin noise level predictions was also verified for reciprocating and turboprop-powered business aircraft.

The program computer code was written in modular form with extensive internal documentation. It is based primarily on accepted NASA noise prediction procedures, where applicable, for gas turbine engine components, modified to more accurately represent general aviation-sized engine components. A new procedure was established under this contract for centrifugal compressor noise predictions, based on in-house contractor data.

The following enhancements to program NOISE are recommended:

- <u>Enhancements to Component Noise Prediction Procedures</u>

  Further analysis should be performed, using an extended engine/component data base, for the following items:

  - Fan discrete and combination tone noise prediction procedures

- Separation of centrifugal compressor discrete and broadband components; inclusion of the effects of cutoff on the fundamental discrete tone

- Far-field attenuation of combustor noise due to turbine transmission losses, particularly for radial turbine applications

- Radial turbine broadband noise prediction procedure.

o <u>Addition of Measured Static Engine Noise Data Module</u>

Aircraft manufacturers frequently would prefer to utilize measured static engine acoustic test data, when it is available, as the basis for flyover noise level predictions.

Component static noise spectra for a specific engine would be synthesized within program NOISE from a combination of predicted component and measured engine static noise levels and spectral shapes. An improved static noise model of the specific engine being studied should result. The synthesized spectra, with appropriate static-to-flight corrections, would be projected to the flight condition.

The inclusion of such a procedure into the NOISE program would increase the accuracy of the flyover predictions, and would be of added benefit to general aviation aircraft manufacturers during their preliminary design tradeoff studies.

o **Addition of Acoustic Treatment Design/Prediction Module**

Increased emphasis is being placed on the reduction of aircraft noise levels at general aviation airports. To meet the present and future noise standards of many such airports, the inclusion of engine acoustic treatment may be necessary in advanced general aviation aircraft preliminary design studies. An acoustic treatment module within program NOISE would calculate the attenuation spectrum that can be obtained within a user-specified treatment envelope for each noise source selected for treatment. Flyover prediction comparisons of the treated and untreated engine would indicate the degree of attenuation that could be achieved. The maximum feasible noise reduction for a given treatment envelope and the sources having the greatest potential for effective treatment would be identified. Additional enhancements could include the effect of acoustic treatment designs upon weight, performance and cost parameters.

o **Integration of Program Noise into the GASP System**

At the present time, NOISE is an independent, self-contained program. For a GASP-based design study requiring noise-level estimates, the user must manually extract certain input and output GASP variables and provide them as input to NOISE. This increases both the possibility of input data errors and the total schedule time required to complete the design study. The integration of NOISE into GASP would decrease or eliminate these potential problems and would provide the user with a single design system for all trade-off studies.

APPENDIX A

Sample Test Case 1

Approach Condition for a Turbofan-Powered Executive Aircraft

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```
                                        NASA LEWIS RESEARCH CENTER                                  PAGE   1
                                        NASA GASP NOISE MODULE OUTPUT
******************************************************************************************************************************************
                         TF?731/LEAR36 APPROACH SIMULATION FLYOVER NOISE PREDICTION
******************************************************************************************************************************************
                                             INPUT DATA - USER INPUT AND DEFAULT VALUES USED
******************************************************************************************************************************************
CONTROL VARIABLES  *
********************

IFAA= 1   APPROACH,     IPOUT= 3   FULL     ,              ISTAG= 3            ICAB= 0             ISI= 0  (ENGL UNITS)

************************
ENVIRONMENTAL VARIABLES*
************************

TAMB=536.7          PAMB= 2116.2        RH= 70.             DIST= 100.0         NLOC= 16

ANGLE (ARRAY) =  10.0  20.0  30.0  40.0  50.0  60.0  70.0  80.0  90.0 100.0 110.0 120.0 130.0 140.0 150.0 160.0


************************
ENGINE/AIRCRAFT SYSTEM *
************************

+++++ENGINE VARIABLES+++++
ENGINE TYPE(NTYE)= 1  (FAN )  ........................ENGINE COMPONENT ARRAY(ICOMP) =     1    4    5    6    0    0
                                                                                       FAN  COMB  JET  ATUR NONE NONE

+++++AIRFRAME VARIABLES+++++
AMACH=0.22          VEL= 253.2          ENP= 2.             ANENGI=  0.0        ANENGE=  0.0        XL=  5.5
YL=  2.6            ZL= 16.7            WGMAX= 17000.       LOCENG= 1           IPHASE= 0           IDOP= 1

****************
FLIGHT PROFILE *
****************

IDPRO= 0                                VEL= 253.2          AMACH=0.22          FLTANG= 3.0         ANGAFT= 4.0
TOROLL=    0.       APDIST=10685.8      XALT=1000.

*****A STRAIGHT LINE PROFILE WILL BE COMPUTED FROM A COMBINATION OF THE ABOVE VARIABLES.

****************
FLIGHT OPTIONS *
****************

KGOLD=  0           XLSIDE=     0.0     XRSIDE=     0.0     IQS=  1             ICUT=  0            IPSEUD=  1
IDUR= 0             XTOL= 100.          IWING= 0
XFAA= 7019.,21325.,21325.,    0.,       YFAA=    4.,    4.,    4.,    4.,       ZFAA=    0.,    0., 1476.,    0.,
```

```
*****************************************************************************************************************************
                         TFE731/LEAR36 APPROACH SIMULATION FLYOVER NOISE PREDICTION
*****************************************************************************************************************************
************************************
ENGINE COMPONENT VARIABLES AT INPUT*
************************************

+++++FAN +++++
IGV= 0            IFD= 0            NH= 8             NSTG= 1           NBF= 30           NVAN=109
RSS=200.00        WAFAN= 79.18      RPM=  8391.       DELT= 45.50       FPR= 0.0          FANDIA= 2.3190
FANHUB= 1.1250    TIPMD=1.4800      TIPM=0.0          FANEFF=0.0        NBF2=  0          NVAN2=  0
FAND2= 0.0        TIPMD2=0.0        TIPM2=0.0         RSS2=100.00       PRAT= 0.0         TRAT=0.0
FANEF2=0.0        IBUZ= 0           ITONE= 0          AMACH=0.2229      CAEF= 40.0

+++++COMB+++++
WACOMB=  17.35    T3=1036.0         T4=1875.0         P3= 14472.0       CAEC= 20.0
AMACH=0.223

+++++JET +++++
VJ= 791.7         TJ=1254.7         DJ= 0.9594        HJ=0.50000        GAMJ=1.3330       VJ2= 692.1
TJ2= 587.2        DJ2= 1.6292       HJ2=0.33490       GAMJ2=1.4010      EL2=  0.78        ALFAJ= 0.0
PHIJ= 0.0         V0= 253.2         INVOPT= 0

+++++ATUR+++++
RPMT= 15094.0     DT= 1.266         DH= 0.745         ACNZ= 0.824       NBT= 80           DTOT=0.35000
PRTS= 0.0         GAMAT=1.33300     CAET= 40.0        AMACH=0.223

***** A DOPPLER FREQUENCY SHIFT WILL BE APPLIED TO ALL SOURCE STATIC SPECTRA AS A FUNCTION OF FLIGHT MACH NO. AND ANGLE FROM INLET.
```

NASA LEWIS RESEARCH CENTER
NASA GASP NOISE MODULE OUTPUT

LEAR36/TFE731 NOISE PREDICTION AT FAR36 APPROACH CONDITION

FLIGHT PROFILE GENERATED FOR FLYOVER PREDICTIONS

VEL= 253.2 AMACH=0.223 TOROLL= 4500. APDIST=10685. XALT=1000. (FOR LEVEL FLYOVER)

TIME SECONDS	IPRO	RANGE FEET	ALTITUDE FEET	AIRCRAFT ANGLE OF ATTACK,DEG	FLIGHT ANGLE DEG
0.0	1	10685.0	560.0	4.0	3.0
0.5	2	10558.6	553.3	4.0	3.0
1.0	3	10432.1	546.7	4.0	3.0
1.5	4	10305.7	540.1	4.0	3.0
2.0	[illegible]	[illegible]79.3	533.5	4.0	3.0
2.5	6	10052.9	526.8	4.0	3.0
3.0	7	9926.4	520.2	4.0	3.0
3.5	8	9800.0	513.6	4.0	3.0
4.0	9	9673.6	507.0	4.0	3.0
4.5	10	9547.2	500.3	4.0	3.0
5.0	11	9420.7	493.7	4.0	3.0
5.5	12	9294.3	487.1	[illegible].0	3.0
6.0	13	9167.9	480.5	4.0	3.0
6.5	14	9041.5	473.8	4.0	3.0
7.0	15	8915.0	467.2	4.0	3.0
7.5	16	8788.6	460.6	4.0	3.0
8.0	17	8662.2	454.0	4.0	3.0
8.5	18	8535.7	447.3	4.0	3.0
9.0	19	8409.3	440.7	4.0	3.0
9.5	20	8282.9	434.1	4.0	3.0
10.0	21	8156.5	427.5	4.0	3.0
10.5	22	8030.0	420.8	4.0	3.0
11.0	23	7903.6	414.2	4.0	3.0
11.5	24	7777.2	407.6	4.0	3.0
12.0	25	7650.8	401.0	4.0	3.0
12.5	26	7524.3	394.3	4.0	3.0
13.0	27	7397.9	387.7	4.0	3.0
13.5	28	7271.5	381.1	4.0	3.0
14.0	29	7145.1	374.5	4.0	3.0
14.5	30	7018.6	367.8	4.0	3.0
15.0	31	6892.2	361.2	4.0	3.0
15.5	32	6765.8	354.6	4.0	3.0
16.0	33	6639.4	347.9	4.0	3.0
16.5	34	6512.9	341.3	4.0	3.0
17.0	35	6386.5	334.7	4.0	3.0
17.5	36	6260.1	328.1	4.0	3.0

18.0	37	6133.6	321.4	4.0	3.0
18.5	38	6007.2	314.8	4.0	3.0
19.0	39	5880.8	308.2	4.0	3.0
19.5	40	5754.4	301.6	4.0	3.0
20.0	41	5627.9	294.9	4.0	3.0
20.5	42	5501.5	288.3	4.0	3.0
21.0	43	5375.1	281.7	4.0	3.0
21.5	44	5248.7	275.1	4.0	3.0
22.0	45	5122.2	268.4	4.0	3.0
22.5	46	4995.8	261.8	4.0	3.0
23.0	47	4869.4	255.2	4.0	3.0
23.5	48	4743.0	248.6	4.0	3.0
24.0	49	4616.5	241.9	4.0	3.0
24.5	50	4490.1	235.3	4.0	3.0
25.0	51	4363.7	228.7	4.0	3.0
25.5	52	4237.2	222.1	4.0	3.0
26.0	53	4110.8	215.4	4.0	3.0
26.5	54	3984.4	208.8	4.0	3.0
27.0	55	3858.0	202.2	4.0	3.0
27.5	56	3731.5	195.6	4.0	3.0
28.0	57	3605.1	188.9	4.0	3.0
28.5	58	3478.7	182.3	4.0	3.0
29.0	59	3352.3	175.7	4.0	3.0
29.5	60	3225.8	169.1	4.0	3.0
30.0	61	3099.4	162.4	4.0	3.0
30.5	62	2973.0	155.8	4.0	3.0
31.0	63	2846.6	149.2	4.0	3.0
31.5	64	2720.1	142.6	4.0	3.0
32.0	65	2593.7	135.9	4.0	3.0
32.5	66	2467.3	129.3	4.0	3.0
33.0	67	2340.9	122.7	4.0	3.0
33.5	68	2214.4	116.1	4.0	3.0
34.0	69	2088.0	109.4	4.0	3.0
34.5	70	1961.6	102.8	4.0	3.0
35.0	71	1835.2	96.2	4.0	3.0
35.5	72	1708.7	89.5	4.0	3.0
36.0	73	1582.3	82.9	4.0	3.0
36.5	74	1455.9	76.3	4.0	3.0
37.0	75	1329.4	69.7	4.0	3.0
37.5	76	1203.0	63.0	4.0	3.0
38.0	77	1076.6	56.4	4.0	3.0
38.5	78	950.2	49.8	4.0	3.0
39.0	79	823.7	43.2	4.0	3.0
39.5	80	697.3	36.5	4.0	3.0
40.0	81	570.9	29.9	4.0	3.0
40.5	82	444.5	23.3	4.0	3.0
41.0	83	318.0	16.7	4.0	3.0
41.5	84	191.6	10.0	4.0	3.0
42.0	85	65.2	3.4	4.0	3.0

NASA LEWIS RESEARCH CENTER
NASA GASP NOISE MODULE OUTPUT

LEAR36/TFE731 NOISE PREDICTION AT FAR36 APPROACH CONDITION

NOISE SOURCE= F/NI ** DISTANCE = 100.0 ** ONE-THIRD OCTAVE BAND AND OVERALL ENGINE COMPONENT SOURCE NOISE LEVEL SUMMARY

1/3 OCTAVE BAND CENTER FREQUENCY	SOUND PRESSURE LEVEL,DB MIKE LOCATIONS IN DEGREES 10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.	SOUND POWER LEVEL,DB
20.0	5.3	5.1	4.7	4.3	3.7	3.1	2.4	1.7	1.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	52.5
25.0	5.3	5.1	4.7	4.3	3.7	3.1	2.4	1.7	1.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	52.5
31.5	5.3	5.1	4.7	4.3	3.7	3.1	2.4	1.7	1.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	52.5
40.0	5.3	5.1	4.7	4.3	3.7	3.1	2.4	1.7	1.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	52.5
50.0	5.3	5.1	4.7	4.3	3.7	3.1	2.4	1.7	1.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	52.5
63.0	5.4	5.2	4.8	4.4	3.8	3.2	2.4	1.7	1.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	52.6
80.0	5.8	5.7	5.5	5.3	4.6	3.8	2.7	1.9	1.1	0.4	0.0	0.0	0.0	0.0	0.0	0.0	53.0
100.0	7.9	8.4	8.4	8.5	7.4	6.1	4.5	3.0	1.8	0.8	0.0	0.0	0.0	0.0	0.0	0.0	54.9
125.0	12.8	13.7	13.9	14.2	12.7	10.9	8.7	6.4	4.1	2.1	0.5	0.0	0.0	0.0	0.0	0.0	59.3
160.0	19.1	20.3	20.5	20.9	19.4	17.5	15.4	12.5	9.3	5.9	2.6	0.3	0.0	0.0	0.0	0.0	65.7
200.0	26.4	27.6	27.8	28.1	26.5	24.4	21.8	18.7	15.1	11.2	6.6	2.6	0.0	0.0	0.0	0.0	72.6
250.0	32.8	33.9	34.1	34.4	32.6	30.5	27.8	24.6	21.0	16.9	11.8	6.7	2.5	0.0	0.0	0.0	78.8
315.0	38.8	39.9	40.1	40.3	38.5	36.3	33.7	30.5	26.8	22.6	17.4	11.8	6.5	2.2	0.0	0.0	84.8
400.0	44.6	45.7	45.9	46.1	44.3	42.1	39.5	36.2	32.4	28.1	22.8	17.0	11.2	5.9	1.6	0.0	90.6
500.0	50.3	51.4	51.5	51.6	49.7	47.4	44.5	41.2	37.3	32.9	27.6	21.7	15.8	10.1	4.9	0.8	96.0
630.0	55.2	56.3	56.3	56.4	54.5	52.2	49.3	45.9	42.0	37.6	32.2	26.3	20.3	14.5	8.8	3.7	100.9
800.0	59.9	61.0	61.0	61.1	59.2	56.7	53.9	50.4	46.5	42.0	36.5	30.5	24.4	18.5	12.5	6.9	105.5
1000.0	64.4	65.4	65.4	65.4	63.4	60.9	57.9	54.3	50.3	45.7	40.1	34.1	28.0	21.9	15.9	10.1	109.9
1250.0	68.3	69.2	69.2	69.2	67.1	64.5	61.4	57.8	53.7	49.1	43.5	37.5	31.4	25.4	19.4	13.4	113.6
1600.0	71.7	72.7	72.6	72.5	70.5	67.9	64.9	61.3	57.1	52.4	46.8	40.6	34.4	28.3	22.2	16.2	117.1
2000.0	75.1	76.1	76.0	75.8	73.7	71.0	67.8	64.0	59.8	55.0	49.3	43.1	36.9	30.7	24.6	18.5	120.4
2500.0	77.8	78.7	78.6	78.4	76.2	73.4	70.2	66.4	62.1	57.3	51.5	45.3	39.0	30.9	24.8	18.9	123.1
3150.0	80.1	81.0	80.8	80.6	78.4	75.6	71.2	67.7	64.1	60.3	55.8	51.2	46.8	46.6	42.0	37.3	125.4
4000.0	81.9	82.9	83.0	83.2	81.7	80.1	80.7	78.1	73.7	68.5	62.8	56.7	50.1	39.2	32.3	25.7	129.4
5000.0	88.4	89.6	89.3	88.9	86.8	83.8	77.3	72.4	67.0	61.4	55.0	48.2	41.6	34.7	28.6	22.6	133.9
6300.0	85.1	85.8	85.4	84.8	82.1	79.0	75.0	71.3	67.7	63.9	59.5	55.0	50.8	51.1	46.5	41.8	130.1
8000.0	85.3	86.3	86.4	86.6	85.2	83.6	84.9	82.2	77.8	72.4	66.5	60.3	53.5	40.3	33.2	26.4	133.8
10000.0	91.6	92.9	92.5	92.0	89.8	86.6	78.3	73.1	67.7	62.6	57.2	51.9	47.0	46.8	42.2	37.6	138.1
12500.0	85.3	86.0	85.5	85.1	82.9	80.6	80.9	78.1	73.8	68.8	63.4	57.9	52.4	45.5	40.2	35.1	133.0
16000.0	87.4	88.6	88.3	87.9	85.9	83.3	79.0	75.1	70.0	64.5	58.6	52.7	47.0	41.5	36.1	30.9	136.5
20000.0	84.6	85.5	84.9	84.3	81.9	78.9	75.5	71.6	66.5	61.0	55.0	49.0	43.1	37.5	32.0	26.8	134.3

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OA(20-20K)																	
LINEAR	96.4	97.5	97.2	96.8	94.7	92.0	89.3	86.1	81.6	76.4	70.8	65.0	59.1	54.8	50.0	45.1	143.6
A-SCALE	94.7	95.8	95.5	95.2	93.1	90.5	88.0	84.8	80.4	75.3	69.7	63.9	58.0	54.1	49.3	44.5	141.2
++++++++++																	
OA(50-10K)																	
LINEAR	95.0	96.2	95.9	95.5	93.5	90.7	87.9	84.7	80.3	75.1	69.5	63.6	57.6	53.9	49.2	44.4	141.4
A-SCALE	94.3	95.4	95.1	94.8	92.7	90.1	87.5	84.3	79.9	74.8	69.2	63.4	57.4	53.8	49.0	44.2	140.5
++++++++++																	
PERCEIVED NOISE LEVL																	
PNL	106.1	107.2	107.0	106.7	104.6	101.9	99.3	96.1	91.8	86.8	81.2	75.4	69.2	66.1	61.1	56.0	
PNLTC	107.2	108.4	108.1	107.8	105.7	102.5	101.4	98.8	94.6	89.4	82.9	76.9	70.7	69.9	65.6	61.1	

*****STATIC LEVELS AT AMBIENT CORRECTED TO FAA STD DAY CONDITIONS (77 DEG F, 70 PCT RH) FOR FLYOVER PREDICTIONS ONLY

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NASA LEWIS RESEARCH CENTER
NASA GASP NOISE MODULE OUTPUT

LEAR36/TFE731 NOISE PREDICTION AT FAR36 APPROACH CONDITION

NOISE SOURCE= FAND ** DISTANCE = 100.0 ** ONE-THIRD OCTAVE BAND AND OVERALL ENGINE COMPONENT SOURCE NOISE LEVEL SUMMARY

1/3 OCTAVE BAND CENTER FREQUENCY	SOUND PRESSURE LEVEL,DB MIKE LOCATIONS IN DEGREES 10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.	SOUND POWER LEVEL,DB
20.0	5.3	5.1	4.7	4.3	3.7	3.1	2.4	1.7	1.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	52.5
25.0	5.3	5.1	4.7	4.3	3.7	3.1	2.4	1.7	1.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	52.5
31.5	5.3	5.1	4.7	4.3	3.7	3.1	2.4	1.7	1.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	52.5
40.0	5.3	5.1	4.7	4.3	3.7	3.1	2.4	1.7	1.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	52.5
50.0	5.3	5.1	4.7	4.2	3.7	3.0	2.4	1.7	1.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	52.5
63.0	5.3	5.1	4.7	4.2	3.7	3.1	2.4	1.8	1.4	1.2	1.3	1.5	1.5	0.4	0.0	0.0	52.9
80.0	5.3	5.1	4.7	4.3	3.7	3.1	2.6	2.5	3.0	4.1	5.2	6.1	6.5	5.2	2.3	0.2	54.7
100.0	5.3	5.1	4.7	4.3	3.8	3.6	3.8	5.2	7.3	9.5	11.3	12.5	13.1	11.4	7.9	4.6	59.3
125.0	5.3	5.1	4.8	4.5	4.4	5.2	7.3	10.3	13.5	16.2	18.2	19.5	20.2	18.8	15.1	11.4	65.8
160.0	5.3	5.2	5.1	5.3	6.6	9.3	13.5	17.3	20.7	23.4	25.3	26.5	27.1	25.3	21.5	17.7	72.6
200.0	5.5	5.6	6.3	8.1	11.2	15.3	19.8	23.6	27.0	29.6	31.4	32.6	33.2	31.4	27.5	23.7	78.7
250.0	6.1	7.1	9.3	12.6	16.8	21.2	25.8	29.6	33.0	35.6	37.4	38.5	39.1	37.3	33.4	29.5	84.7
315.0	7.9	10.4	13.9	18.1	22.5	27.1	31.7	35.5	38.8	41.4	43.1	44.3	44.8	43.0	39.1	35.2	90.4
400.0	11.5	15.2	19.3	23.7	28.2	32.8	37.5	41.2	44.4	46.9	48.6	49.6	50.0	48.1	44.2	40.2	95.8
500.0	16.4	20.5	24.8	29.2	33.7	38.1	42.5	46.2	49.3	51.8	53.4	54.4	54.8	52.9	48.9	44.9	100.6
630.0	21.1	25.3	29.7	34.1	38.5	42.9	47.3	50.9	54.0	56.4	58.0	59.0	59.3	57.5	53.5	49.5	105.3
800.0	25.7	30.0	34.3	38.7	43.1	47.5	51.9	55.5	58.5	60.8	62.3	63.2	63.5	61.4	57.4	53.4	109.5
1000.0	30.2	34.5	38.8	43.1	47.3	51.6	55.9	59.3	62.3	64.5	65.9	66.8	67.0	64.9	60.9	56.9	113.2
1250.0	34.0	38.3	42.5	46.8	51.0	55.2	59.4	62.8	65.7	67.9	69.4	70.2	70.4	68.4	64.4	60.3	116.7
1600.0	37.4	41.7	45.9	50.2	54.4	58.6	62.9	66.3	69.1	71.2	72.6	73.3	73.5	71.3	67.2	63.1	119.9
2000.0	40.8	45.1	49.3	53.5	57.6	61.7	65.8	69.0	71.8	73.9	75.1	75.8	75.9	73.7	69.6	65.5	122.5
2500.0	43.5	47.7	51.9	56.0	60.1	64.2	68.2	71.4	74.1	76.1	77.3	78.0	78.1	75.5	71.4	67.3	124.8
3150.0	45.8	50.0	54.2	58.2	62.3	66.3	69.7	73.1	76.1	78.5	80.0	80.8	81.1	80.1	76.2	72.4	127.8
4000.0	47.6	51.9	56.3	60.8	65.3	69.9	75.9	79.0	81.6	83.2	83.5	83.4	82.9	79.5	75.1	70.9	131.2
5000.0	54.9	58.9	62.7	66.4	69.7	72.9	74.5	76.9	79.0	80.5	81.5	82.0	82.0	79.5	75.3	71.2	127.6
6300.0	50.9	54.8	58.7	62.4	66.2	70.0	73.6	76.8	79.7	82.1	83.5	84.3	84.6	83.8	79.9	76.1	131.9
8000.0	51.0	55.3	59.7	64.2	68.7	73.3	79.7	82.7	85.2	86.5	86.5	86.1	85.3	81.1	76.6	72.2	134.9
10000.0	58.2	62.2	65.8	69.4	72.6	75.4	75.6	77.7	79.7	81.3	82.4	82.9	82.9	81.7	77.7	73.7	131.9
12500.0	51.0	55.0	58.8	62.7	66.7	70.8	76.6	79.5	82.0	83.5	83.8	83.7	83.2	80.2	75.9	71.8	133.7
16000.0	53.9	57.8	61.6	65.3	68.8	72.1	74.6	76.9	79.0	80.2	80.6	80.5	80.1	77.5	73.2	69.0	132.1
20000.0	50.8	54.7	58.3	61.8	65.1	68.4	71.7	74.1	76.1	77.4	77.9	77.9	77.5	74.9	70.5	66.3	130.7

++++++++++																	
OA(20-20K)																	
LINEAR	62.7	66.7	70.5	74.3	77.9	81.5	85.2	88.0	90.5	92.1	92.7	92.8	92.6	90.3	86.2	82.1	141.7
A-SCALE	60.9	64.9	68.8	72.7	76.4	80.1	84.0	86.9	89.4	91.1	91.8	92.0	91.9	89.7	85.6	81.6	140.2
++++++++++																	
OA(50-10K)																	
LINEAR	61.3	65.4	69.2	73.0	76.7	80.2	83.9	86.7	89.2	90.9	91.6	91.8	91.6	89.5	85.4	81.3	139.9
A-SCALE	60.5	64.5	68.4	72.3	76.0	79.7	83.6	86.5	89.0	90.7	91.5	91.7	91.6	89.4	85.3	81.3	139.6
++++++++++																	
PERCEIVED NOISE LEVL																	
PNL	72.5	76.6	80.5	84.3	88.0	91.5	95.4	98.4	101.1	102.8	103.5	103.7	103.5	101.7	97.8	93.8	
PNLTC	74.4	78.4	81.6	85.4	88.9	92.2	96.3	99.3	102.0	103.6	104.1	104.1	103.8	102.3	98.4	94.7	

*****STATIC LEVELS AT AMBIENT CORRECTED TO FAA STD DAY CONDITIONS (77 DEG F, 70 PCT RH) FOR FLYOVER PREDICTIONS ONLY

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LEAR36/TFE731 NOISE PREDICTION AT FAR36 APPROACH CONDITION

NOISE SOURCE= COMB ** DISTANCE = 100.0 ** ONE-THIRD OCTAVE BAND AND OVERALL ENGINE COMPONENT SOURCE NOISE LEVEL SUMMARY

1/3 OCTAVE BAND CENTER FREQUENCY	SOUND PRESSURE LEVEL,DB — MIKE LOCATIONS IN DEGREES																SOUND POWER LEVEL,DB
	10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110	120.	130.	140.	150.	160.	
20.0	28.6	30.3	31.9	33.5	35.4	36.6	37.8	39.0	40.9	42.5	43.5	44.2	44.4	44.4	44.3	44.3	92.1
25.0	32.6	34.3	35.9	37.6	39.4	40.7	41.8	43.1	44.9	46.6	47.6	48.3	48.5	48.6	48.4	48.5	96.2
31.5	36.7	38.4	40.0	41.6	43.5	44.8	45.9	47.2	49.1	50.7	51.8	52.5	52.7	52.9	52.8	52.9	100.4
40.0	40.8	42.5	44.1	45.8	47.7	49.0	50.3	51.6	53.4	55.1	56.1	56.8	57.0	57.2	57.1	57.1	104.7
50.0	45.2	46.9	48.5	50.1	52.1	53.3	54.6	55.8	57.6	59.1	60.0	60.6	60.7	60.6	60.4	60.4	108.5
63.0	49.3	51.0	52.6	54.1	55.9	57.1	58.0	59.1	60.8	62.4	63.3	63.9	64.0	64.1	63.9	63.9	111.9
80.0	52.6	54.3	55.8	57.4	59.2	60.3	61.4	62.6	64.3	65.8	66.7	67.3	67.4	67.5	67.3	67.3	115.3
100.0	56.1	57.8	59.3	60.8	62.6	63.7	64.9	65.9	67.6	69.0	69.8	70.3	70.2	70.0	69.7	69.7	118.3
125.0	59.4	61.1	62.5	64.0	65.7	66.7	67.4	68.4	70.0	71.4	72.2	72.7	72.6	72.7	72.4	72.4	120.8
160.0	61.8	63.4	64.9	66.4	68.1	69.1	70.0	71.0	72.6	74.0	74.8	75.3	75.2	75.3	75.0	74.9	123.4
200.0	64.5	66.1	67.6	69.0	70.7	71.7	72.7	73.6	75.1	76.4	77.0	77.3	77.1	76.8	76.4	76.3	125.5
250.0	67.0	68.6	70.0	71.4	72.9	73.7	74.2	75.0	76.3	77.5	78.1	78.3	78.1	78.1	77.7	77.5	126.8
315.0	68.3	69.8	71.2	72.5	73.9	74.7	75.5	76.2	77.4	78.4	78.7	78.8	78.3	77.8	77.2	77.0	127.4
400.0	69.4	70.9	72.2	73.3	74.6	75.1	75.3	75.7	76.6	77.4	77.6	77.6	77.1	76.6	76.0	75.7	126.6
500.0	68.8	70.2	71.3	72.3	73.5	73.9	74.0	74.3	75.2	76.0	76.1	76.0	75.5	75.1	74.5	74.1	125.3
630.0	67.4	68.8	69.9	70.9	72.0	72.3	72.6	72.8	73.6	74.3	74.3	74.1	73.4	72.7	72.0	71.7	123.5
800.0	65.8	67.2	68.2	69.1	70.1	70.3	70.2	70.3	71.0	71.6	71.5	71.3	70.6	70.0	69.3	68.9	121.0
1000.0	63.2	64.6	65.6	66.4	67.4	67.5	67.5	67.6	68.3	68.8	68.7	68.5	67.8	67.3	66.6	66.2	118.3
1250.0	60.5	61.8	62.8	63.6	64.6	64.7	64.8	64.8	65.5	65.9	65.7	65.4	64.5	63.6	62.9	62.4	115.4
1600.0	57.7	59.0	59.9	60.7	61.5	61.5	61.1	61.0	61.5	61.9	61.6	61.2	60.4	59.7	58.9	58.5	111.7
2000.0	53.8	55.1	55.9	56.7	57.4	57.4	57.2	57.1	57.6	58.0	57.8	57.5	56.7	56.2	55.4	55.0	107.9
2500.0	49.8	51.1	52.0	52.8	53.6	53.6	53.6	53.6	54.2	54.6	54.5	54.1	53.4	52.8	52.0	51.6	104.5
3150.0	46.4	47.7	48.6	49.4	50.2	50.3	50.2	50.1	50.7	51.0	50.8	50.4	49.5	48.7	47.9	47.4	101.0
4000.0	42.8	44.1	45.0	45.7	46.5	46.4	46.1	46.0	46.4	46.7	46.5	46.0	45.2	44.5	43.7	43.3	97.1
5000.0	38.7	39.9	40.8	41.5	42.2	42.2	42.0	41.8	42.3	42.6	42.3	41.9	41.0	40.3	39.5	39.0	93.0
6300.0	34.4	35.7	36.5	37.2	37.9	37.9	37.7	37.5	37.9	38.1	37.8	37.2	36.3	35.3	34.5	34.0	88.8
8000.0	29.9	31.1	31.9	32.6	33.2	33.0	32.5	32.3	32.6	32.7	32.4	31.8	30.9	30.1	29.2	28.7	84.1
10000.0	24.4	25.7	26.4	27.0	27.7	27.5	27.1	26.9	27.2	27.4	27.0	26.5	25.5	24.8	23.9	23.4	79.2
12500.0	18.8	20.0	20.8	21.4	22.0	21.8	21.5	21.2	21.5	21.6	21.1	20.5	19.4	18.3	17.4	16.8	74.2
16000.0	12.6	13.8	14.5	15.1	15.6	15.3	14.5	14.1	14.3	14.3	13.8	13.2	12.1	11.3	10.4	9.9	68.7
20000.0	5.4	6.6	7.3	7.8	8.3	7.9	7.6	7.2	7.4	7.5	7.0	6.4	5.4	4.5	3.6	3.0	63.0

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OA(20-20K)																	
LINEAR	76.8	78.3	79.5	80.6	82.0	82.5	83.0	83.6	84.7	85.7	86.1	86.2	85.9	85.6	85.1	84.9	134.9
A-SCALE	73.1	74.5	75.6	76.7	77.8	78.2	78.4	78.7	79.7	80.4	80.6	80.5	80.0	79.5	78.9	78.6	129.7
++++++++++																	
OA(50-10K)																	
LINEAR	76.8	78.3	79.5	80.6	82.0	82.5	83.0	83.6	84.7	85.7	86.1	86.2	85.9	85.6	85.1	84.9	134.9
A-SCALE	73.1	74.5	75.6	76.7	77.8	78.2	78.4	78.7	79.7	80.4	80.6	80.5	80.0	79.5	78.9	78.6	129.7
++++++++++																	
PERCEIVED NOISE LEVL																	
PNL	82.6	84.1	85.3	86.4	87.6	88.1	88.4	88.8	89.8	90.6	90.8	90.8	90.3	89.8	89.2	89.0	
PNLTC	82.7	84.2	85.4	86.5	87.7	88.2	88.5	88.9	89.9	90.7	90.9	90.9	90.4	89.9	89.4	89.1	

*****STATIC LEVELS AT AMBIENT CORRECTED TO FAA STD DAY CONDITIONS (77 DEG F, 70 PCT RH) FOR FLYOVER PREDICTIONS ONLY

ORIGINAL PAGE IS OF POOR QUALITY

NASA LEWIS RESEARCH CENTER
NASA GASP NOISE MODULE OUTPUT

TFE731/LEAR36 APPROACH SIMULATION FLYOVER NOISE PREDICTION

NOISE SOURCE= JET ** DISTANCE = 100.0 ** ONE-THIRD OCTAVE BAND AND OVERALL ENGINE COMPONENT SOURCE NOISE LEVEL SUMMARY

1/3 OCTAVE BAND CENTER FREQUENCY	SOUND PRESSURE LEVEL,DB MIKE LOCATIONS IN DEGREES 10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.	SOUND POWER LEVEL,DB
20.0	57.3	57.4	57.6	57.8	58.1	58.4	58.8	59.3	59.8	60.4	61.0	61.6	64.0	68.0	70.4	70.5	114.0
25.0	59.4	59.5	59.7	59.9	60.2	60.6	61.0	61.4	62.0	62.5	63.1	63.8	66.3	70.9	73.2	72.6	116.4
31.5	61.7	61.8	61.9	62.1	62.4	62.8	63.2	63.7	64.2	64.8	65.4	66.0	69.1	73.8	75.5	74.3	118.7
40.0	64.0	64.1	64.3	64.5	64.8	65.1	65.5	66.0	66.5	67.1	67.7	68.3	71.5	75.8	77.2	75.9	120.7
50.0	65.9	66.0	6.2	66.4	66.6	67.0	67.4	67.8	68.4	68.9	69.5	70.2	73.2	77.0	78.5	77.4	122.3
63.0	67.5	67.6	67.7	67.9	68.2	68.5	68.9	69.4	69.9	70.4	71.0	71.8	74.9	78.1	79.5	78.6	123.6
80.0	68.7	68.8	68.9	69.1	69.4	69.7	70.1	70.6	71.1	71.6	72.2	73.3	76.4	79.2	80.3	79.2	124.6
100.0	69.7	69.7	69.9	70.1	70.4	70.7	71.1	71.5	72.0	72.5	73.1	74.5	77.3	79.5	80.4	79.0	125.2
125.0	70.5	70.6	70.7	70.9	71.2	71.5	71.9	72.3	72.8	73.4	73.9	75.6	77.9	79.3	79.8	78.0	125.4
160.0	71.2	71.3	71.5	71.7	71.9	72.2	72.6	73.1	73.5	74.1	74.6	76.2	78.0	78.8	78.6	76.1	125.4
200.0	71.7	71.8	71.9	72.1	72.4	72.7	73.1	73.5	74.0	74.5	75.0	76.5	77.6	77.9	77.1	74.3	125.3
250.0	72.0	72.1	72.2	72.4	72.7	73.0	73.3	73.8	74.2	74.8	75.3	76.4	76.8	76.5	75.5	72.5	125.1
315.0	72.2	72.2	72.4	72.6	72.8	73.1	73.5	73.9	74.4	74.9	75.4	76.2	76.0	75.1	73.8	70.7	124.8
400.0	72.1	72.1	72.3	72.5	72.7	73.0	73.4	73.8	74.3	74.8	75.3	75.8	75.0	73.6	72.1	68.7	124.4
500.0	71.9	72.0	72.1	72.3	72.6	72.9	73.2	73.6	74.1	74.6	75.1	75.3	73.9	72.2	70.4	67.0	124.1
630.0	71.5	71.6	71.7	71.9	72.1	72.4	72.8	73.2	73.7	74.2	74.7	74.6	72.8	70.7	68.7	65.1	123.5
800.0	70.9	71.0	71.1	71.3	71.5	71.8	72.1	72.6	73.0	73.5	74.0	73.7	71.6	69.2	67.0	63.2	122.8
1000.0	70.2	70.3	70.4	70.6	70.8	71.1	71.5	71.9	72.3	72.8	73.4	72.8	70.4	67.8	65.3	61.4	122.0
1250.0	69.5	69.6	69.7	69.9	70.1	70.4	70.8	71.2	71.6	72.1	72.6	71.9	69.3	66.4	63.7	59.6	121.3
1600.0	68.5	68.6	68.7	68.9	69.1	69.4	69.8	70.2	70.6	71.1	71.6	70.8	68.0	64.9	61.9	57.6	120.3
2000.0	67.6	67.6	67.7	67.9	68.2	68.4	68.8	69.2	69.6	70.1	70.6	69.7	66.8	63.5	60.2	55.9	119.4
2500.0	66.5	66.6	66.7	66.9	67.1	67.4	67.7	68.1	68.6	69.1	69.6	68.6	65.6	62.0	58.6	54.1	118.4
3150.0	65.4	65.5	65.6	65.8	66.0	66.3	66.6	67.0	67.5	68.0	68.5	67.5	64.3	60.6	56.9	52.2	117.4
4000.0	64.2	64.3	64.4	64.6	64.8	65.1	65.5	65.9	66.3	66.8	67.3	66.2	63.0	59.1	55.1	50.3	116.4
5000.0	63.1	63.1	63.3	63.4	63.7	63.9	64.3	64.7	65.1	65.6	66.1	65.1	61.8	57.7	53.5	48.5	115.3
6300.0	61.9	61.9	62.1	62.2	62.5	62.8	63.1	63.5	64.0	64.4	64.9	63.9	60.5	56.2	51.8	46.7	114.3
8000.0	60.7	60.8	60.9	61.1	61.3	61.6	61.9	62.3	62.8	63.3	63.8	62.7	59.2	54.7	50.0	44.8	113.5
10000.0	59.6	59.6	59.7	59.9	60.1	60.4	60.8	61.2	61.6	62.1	62.6	61.5	58.0	53.3	48.4	43.0	112.9
12500.0	58.4	58.5	58.6	58.8	59.0	59.3	59.6	60.0	60.5	60.9	61.5	60.3	56.8	51.9	46.8	41.2	112.6
16000.0	57.1	57.2	57.3	57.5	57.7	58.0	58.3	58.7	59.2	59.7	60.2	59.1	55.5	50.3	44.9	39.2	112.7
20000.0	55.9	56.0	56.1	56.3	56.5	56.8	57.2	57.6	58.0	58.5	59.0	57.9	54.3	48.9	43.3	37.4	112.9

ORIGINAL PAGE IS
OF POOR QUALITY

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OA(20-20K)																	
LINEAR	83.3	83.3	83.5	83.7	83.9	84.2	84.6	85.0	85.5	86.0	86.5	87.0	87.6	88.7	89.2	87.5	136.7
A-SCALE	79.9	79.9	80.1	80.2	80.5	80.8	81.1	81.5	82.0	82.5	83.0	82.7	80.9	79.0	77.3	74.1	132.0
++++++++++																	
OA(50-10K)																	
LINEAR	83.1	83.2	83.3	83.5	83.8	84.1	84.4	84.8	85.3	85.8	86.4	86.9	87.4	88.3	88.5	86.7	136.4
A-SCALE	79.9	79.9	80.0	80.2	80.5	80.8	81.1	81.5	82.0	82.5	83.0	82.6	80.8	79.0	77.3	74.1	131.9
++++++++++																	
PERCEIVED NOISE LEVL																	
PNL	92.6	92.7	92.8	93.0	93.2	93.5	93.9	94.3	94.8	95.3	95.8	95.5	93.8	92.6	91.2	88.1	
PNLTC	92.6	92.7	92.8	93.0	93.3	93.6	93.9	94.3	94.8	95.3	95.8	95.5	93.8	92.6	91.2	88.2	

*****STATIC LEVELS AT AMBIENT CORRECTED TO FAA STD DAY CONDITIONS (77 DEG F, 70 PCT RH) FOR FLYOVER PREDICTIONS ONLY

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NASA GASP NOISE MODULE OUTPUT

LEAR36/TFE731 NOISE PREDICTION AT FAR36 APPROACH CONDITION

NOISE SOURCE= ATUR ** DISTANCE = 100.0 ** ONE-THIRD OCTAVE BAND AND OVERALL ENGINE COMPONENT SOURCE NOISE LEVEL SUMMARY

1/3 OCTAVE BAND CENTER FREQUENCY	SOUND PRESSURE LEVEL,DB MIKE LOCATIONS IN DEGREES 10.	20	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.	SOUND POWER LEVEL,DB
20.0	42.6	43.4	44.1	44.8	45.3	45.9	46.3	46.8	47.3	51.3	53.3	52.3	48.5	43.7	39.5	37.3	99.0
25.0	43.5	44.4	45.1	45.7	46.3	46.8	47.3	47.8	48.3	52.3	54.3	53.3	49.5	44.7	40.5	38.3	100.0
31.5	44.5	45.3	46.1	46.7	47.3	47.8	48.3	48.8	49.3	53.3	55.3	54.3	50.5	45.8	41.5	39.3	101.0
40.0	45.5	46.3	47.1	47.7	48.3	48.8	49.3	49.8	50.3	54.3	56.3	55.3	51.6	46.8	42.5	40.3	102.0
50.0	46.5	47.4	48.1	48.7	49.3	49.8	50.3	50.8	51.3	55.3	57.3	56.3	52.5	47.7	43.5	41.3	103.0
63.0	47.5	48.4	49.1	49.7	50.3	50.8	51.3	51.8	52.3	56.3	58.3	57.3	53.6	48.8	44.5	42.4	104.0
80.0	48.5	49.4	50.1	50.7	51.3	51.9	52.4	52.8	53.3	57.3	59.3	58.3	54.6	49.8	45.5	43.4	105.0
100.0	49.6	50.4	51.1	51.8	52.3	52.9	53.4	53.8	54.3	58.3	60.3	59.3	55.5	50.7	46.5	44.3	106.0
125.0	50.6	51.4	52.1	52.8	53.3	53.8	54.3	54.8	55.3	59.3	61.3	60.3	56.6	51.8	47.6	45.4	107.0
160.0	51.5	52.3	53.1	53.7	54.3	54.8	55.4	55.9	56.4	60.4	62.4	61.4	57.6	52.8	48.5	46.4	108.1
200.0	52.6	53.4	54.2	54.8	55.4	55.9	56.4	56.8	57.3	61.3	63.3	62.3	58.6	53.8	49.5	47.4	109.0
250.0	53.6	54.4	55.1	55.8	56.3	56.9	57.3	57.8	58.3	62.3	64.3	63.3	59.6	54.8	50.6	48.4	110.0
315.0	54.5	55.4	56.1	56.8	57.3	57.9	58.4	58.8	59.3	63.3	65.4	64.4	60.6	55.8	51.6	49.4	111.1
400.0	55.6	56.4	57.1	57.8	58.4	58.9	59.4	59.9	60.4	64.4	66.4	65.4	61.7	56.9	52.6	50.4	112.2
500.0	56.6	57.5	58.2	58.8	59.4	59.9	60.4	60.9	61.4	65.4	67.4	66.4	62.7	57.9	53.6	51.5	113.2
630.0	57.6	58.4	59.2	59.8	60.4	60.9	61.4	61.9	62.4	66.4	68.5	67.5	63.7	59.0	54.8	52.6	114.2
800.0	58.6	59.5	60.2	60.9	61.4	62.0	62.6	63.0	63.5	67.4	69.4	68.4	64.5	59.6	55.3	53.1	115.2
1000.0	59.7	60.5	61.2	61.9	62.4	62.8	63.1	63.6	64.0	68.0	70.0	69.0	65.2	60.4	56.2	54.0	115.9
1250.0	60.2	61.0	61.8	62.4	62.9	63.5	64.0	64.5	65.0	69.0	71.0	70.0	66.3	61.5	57.3	55.1	116.9
1600.0	61.1	62.0	62.7	63.4	63.9	64.5	65.0	65.5	66.0	70.0	72.1	71.1	67.3	62.4	58.2	56.1	118.0
2000.0	62.2	63.0	63.8	64.4	65.0	65.5	66.0	66.5	67.0	71.1	73.2	72.3	68.7	64.0	59.8	57.7	119.2
2500.0	63.1	64.0	64.8	65.5	66.1	66.8	67.4	68.1	68.7	72.9	75.1	74.3	70.7	66.0	[illegible]	59.8	121.1
3150.0	64.8	65.7	66.5	67.3	68.0	68.8	69.4	70.2	[illegible]	75.2	77.6	76.8	73.3	69.0	64.9	62.8	123.6
4000.0	[illegible]	67.8	68.7	69.6	70.4	71.3	72.3	73.1	[illegible]	78.0	80.1	79.2	75.5	70.6	66.4	64.3	126.3
5000.0	69.9	70.8	71.6	72.4	73.1	73.7	74.1	74.7	[illegible]	79.4	81.6	80.7	77.0	72.4	68.2	66.1	128.0
6300.0	71.2	72.1	72.9	73.6	74.3	75.0	75.7	76.3	76.9	81.1	83.2	82.3	78.6	73.8	69.7	67.5	129.8
8000.0	72.7	73.6	74.4	75.2	75.8	76.5	77.0	77.6	78.2	82.3	84.5	83.6	79.9	75.2	71.0	68.8	131.5
10000.0	73.9	74.7	75.5	76.3	76.9	77.6	78.2	78.8	79.4	83.5	85.7	84.8	81.1	76.2	72.1	70.0	133.2
12500.0	74.7	75.6	76.4	77.1	77.8	78.5	78.9	79.6	80.3	84.6	86.9	86.1	82.6	78.3	74.2	72.1	135.3
16000.0	75.1	76.0	76.9	77.7	78.5	79.3	80.4	81.2	81.9	86.1	88.3	87.5	83.8	78.9	74.7	72.5	138.0
20000.0	76.7	77.6	78.5	79.4	80.3	81.1	81.1	81.8	82.5	86.7	89.0	88.0	84.2	79.3	75.1	72.9	140.0

ORIGINAL PAGE IS OF POOR QUALITY

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OA(20-20K)																	
LINEAR	82.9	83.8	84.6	65.4	86.1	86.9	87.4	88.1	88.7	92.9	95.1	94.2	90.5	85.8	81.6	79.5	144.1
A-SCALE	79.8	80.7	81.5	82.3	83.0	83.7	84.3	84.9	85.6	89.7	91.9	91.0	87.4	82.7	78.5	76.4	139.6
++++++++++																	
OA(50-10K)																	
LINEAR	79.3	80.1	80.9	81.7	32.4	83.0	83.6	84.2	84.8	89.0	91.1	90.2	86.6	81.8	77.6	75.5	138.0
A-SCALE	78.6	79.5	80.3	81.0	81.7	82.4	83.0	83.6	84.2	88.4	90.5	89.6	86.0	81.2	77.1	74.9	137.2
++++++++++																	
PERCEIVED NOISE LEVL																	
PNL	91.2	92.0	92.8	93.6	94.2	94.9	95.5	96.1	96.7	100.9	103.0	102.1	98.4	93.7	89.5	87.3	
PNLTC	91.4	92.2	93.0	93.7	94.4	95.0	95.7	96.3	96.9	101.0	103.1	102.2	98.5	93.8	89.6	87.5	

*****STATIC LEVELS AT AMBIENT CORRECTED TO FAA STD DAY CONDITIONS (77 DEG F, 70 PCT RH) FOR FLYOVER PREDICTIONS ONLY

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TFE731/LEAR36 APPROACH SIMULATION FLYOVER NOISE PREDICTION

NOISE SOURCE= TOTL ** DISTANCE = 100.0 ** ONE-THIRD OCTAVE BAND AND OVERALL ENGINE COMPONENT SOURCE NOISE LEVEL SUMMARY

1/3 OCTAVE BAND CENTER FREQUENCY	SOUND PRESSURE LEVEL,DB — MIKE LOCATIONS IN DEGREES 10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.	SOUND POWER LEVEL,DB
20.0	57.5	57.6	57.8	58.0	58.3	58.7	59.1	59.6	60.1	61.0	61.8	62.2	64.2	68.0	70.4	70.5	114.2
25.0	59.6	59.7	59.9	60.1	60.4	60.8	61.2	61.7	62.2	63.0	63.8	64.3	66.5	70.9	73.2	72.6	116.6
31.5	61.7	61.9	62.1	62.3	62.6	63.0	63.4	63.9	64.5	65.2	66.0	66.5	69.3	73.8	75.5	74.3	118.9
40.0	64.1	64.2	64.4	64.6	64.9	65.3	65.7	66.2	66.8	67.5	68.3	68.8	71.6	75.8	77.2	76.0	120.9
50.0	66.0	66.1	66.3	66.5	66.9	67.2	67.7	68.2	68.8	69.5	70.2	70.8	73.5	77.1	78.5	77.5	122.5
63.0	67.6	67.7	67.9	68.2	68.5	68.9	69.3	69.8	70.4	71.2	71.9	72.6	75.2	78.3	79.6	78.7	123.9
80.0	68.8	69.0	69.2	69.5	69.9	70.3	70.7	71.3	72.0	72.7	73.4	74.4	76.9	79.5	80.5	79.5	125.2
100.0	69.9	70.1	70.3	70.6	71.1	71.5	72.1	72.6	73.4	74.2	74.9	76.0	78.1	80.0	80.8	79.5	126.1
125.0	70.9	71.1	71.4	71.8	72.3	72.8	73.3	73.9	74.7	75.6	76.3	77.4	79.0	80.2	80.5	79.0	126.8
160.0	71.8	72.0	72.4	72.8	73.5	74.0	74.6	75.2	76.2	77.2	77.9	78.9	79.9	80.4	80.2	78.6	127.6
200.0	72.5	72.9	73.3	73.9	74.7	75.3	76.0	76.6	77.6	78.6	79.3	80.0	80.4	80.4	79.8	78.4	128.5
250.0	73.2	73.7	74.3	75.0	75.8	76.4	76.9	77.5	78.5	79.4	80.0	80.6	80.6	80.4	79.8	78.7	129.1
315.0	73.7	74.3	74.9	75.6	76.5	77.0	77.7	78.3	79.2	80.1	80.5	80.8	80.4	79.7	78.9	77.9	129.3
400.0	74.0	74.7	75.3	76.0	76.8	77.2	77.5	77.9	78.7	79.5	79.8	80.0	79.2	78.4	77.5	76.5	128.8
500.0	73.7	74.3	74.9	75.5	76.2	76.5	76.8	77.1	77.8	78.6	79.0	79.0	77.9	76.9	75.9	74.9	127.9
630.0	73.1	73.6	74.1	74.6	75.3	75.6	75.9	76.2	76.8	77.6	78.1	77.8	76.5	75.0	73.8	72.6	126.8
800.0	72.5	73.0	73.4	73.8	74.3	74.5	74.6	75.0	75.5	76.4	77.0	76.6	74.9	73.1	71.6	70.1	125.6
1000.0	72.1	72.6	72.9	73.2	73.3	73.4	73.6	73.9	74.5	75.5	76.3	75.9	74.1	71.9	69.8	68.0	124.7
1250.0	72.5	73.1	73.2	73.4	73.1	72.9	72.9	73.3	74.0	75.4	76.4	76.0	74.2	71.8	68.8	66.1	124.6
1600.0	73.8	74.5	74.6	74.7	73.7	73.0	72.8	73.2	74.1	75.8	77.0	76.8	75.4	72.8	69.2	65.7	125.3
2000.0	76.0	76.9	76.8	76.8	75.3	74.0	73.4	73.8	74.9	76.9	78.2	78.1	77.1	74.6	70.6	66.9	126.7
2500.0	78.3	79.1	79.0	78.9	77.2	75.5	74.6	75.0	76.3	78.4	79.8	79.9	79.0	76.2	72.1	68.3	128.5
3150.0	80.4	81.2	81.1	81.0	79.1	77.2	75.6	76.2	77.9	80.5	82.2	82.4	81.9	80.4	76.6	72.9	130.9
4000.0	82.1	83.1	83.2	83.5	82.2	81.1	82.5	82.2	83.0	84.5	85.3	84.9	83.7	80.1	75.7	71.8	134.2
5000.0	88.5	89.7	89.4	89.0	87.1	84.6	80.4	79.9	80.8	83.1	84.6	84.5	83.2	80.3	76.1	72.4	136.0
6300.0	85.3	86.0	85.6	85.1	82.9	80.9	79.7	80.3	81.8	84.7	86.4	86.5	85.6	84.2	80.3	76.7	135.5
8000.0	85.6	86.6	86.7	86.9	85.7	84.7	86.6	86.1	86.6	88.1	88.7	88.0	86.4	82.1	77.6	73.9	138.4
10000.0	91.7	93.0	92.6	92.1	90.1	87.4	82.3	81.9	82.7	85.6	87.3	86.9	85.1	82.8	78.7	75.2	140.0
12500.0	85.7	86.3	86.0	85.7	84.2	83.0	83.9	83.9	84.6	87.2	88.6	88.1	85.9	82.4	78.2	74.9	138.9
16000.0	87.7	88.8	88.6	88.3	86.7	85.0	83.4	83.3	83.9	87.1	89.0	88.3	85.3	81.3	77.0	74.1	140.9
20000.0	85.2	86.1	85.9	85.5	84.2	83.3	82.6	82.8	83.5	87.2	89.3	88.4	85.0	80.7	76.4	73.7	141.4

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OA(20-20K)																	
LINEAR	96.8	97.9	97.7	97.4	95.8	94.2	93.5	93.5	94.2	96.4	97.8	97.4	95.9	94.1	92.3	90.5	148.5
A-SCALE	95.0	96.0	95.8	95.6	93.9	92.1	91.3	91.2	92.0	94.1	95.3	95.0	93.6	91.1	87.5	84.5	145.5
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OA(50-10K)																	
LINEAR	95.5	96.6	96.3	96.1	94.5	92.8	91.9	91.9	92.8	94.5	95.5	95.4	94.5	93.1	91.6	89.8	145.7
A-SCALE	94.6	95.6	95.4	95.2	93.5	91.7	90.7	90.7	91.5	93.4	94.5	94.3	93.1	90.7	87.2	84.2	144.5
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PERCEIVED NOISE LEVL																	
PNL	108.0	109.0	108.9	108.7	107.3	105.6	104.9	104.9	105.7	107.4	108.4	108.2	107.3	105.6	102.6	99.7	
PNLTC	109.1	110.1	110.0	109.8	108.3	106.4	106.4	105.8	106.5	108.0	108.8	108.5	107.5	106.1	103.2	100.3	

TFE731/LEAR36 APPROACH SIMULATION FLYOVER NOISE PREDICTION

DETAILED FLYOVER NOISE LEVELS,BY COMPONENT, AT EACH 1/2 SECOND INTERVAL ALONG THE PROFILE

TIME SEC	RANGE FEET	ALTITUDE FEET	SLANT DIST,FT	ENGINE-OBSERVER ANGLE,DEG	ELEV ANGLE DEG	COMPONENT	PNL DB	PNLTC DB	OVERALL DB	A-WEIGHTED DB(A)
0.0	10685.0	560.0	3707.9	9.6	8.6	FANI	53.5	56.1	42.1	42.9
						FAND	24.2	24.5	13.1	14.1
						COMB	49.0	49.2	46.3	40.9
						JET	55.9	56.1	52.9	46.4
						ATUR	44.5	45.3	36.6	34.3
						TOTL	60.3	62.7	54.1	49.0
0.5	10558.6	553.3	3581.9	9.8	8.8	FANI	54.5	57.1	42.9	43.7
						FAND	24.3	24.6	13.2	14.2
						COMB	49.5	49.7	46.7	41.4
						JET	56.3	56.5	53.2	46.9
						ATUR	45.2	46.0	37.1	34.9
						TOTL	61.0	63.5	54.5	49.5
1.0	10432.1	546.7	3456.0	10.0	9.0	FANI	55.5	58.0	43.8	44.6
						FAND	24.7	24.9	13.4	14.4
						COMB	50.1	50.3	47.1	42.0
						JET	56.9	57.2	53.6	47.4
						ATUR	45.9	46.6	37.6	35.6
						TOTL	61.8	64.3	54.9	50.1
1.5	10305.7	540.1	3330.2	10.3	9.3	FANI	56.5	58.9	44.6	45.5
						FAND	25.3	25.6	13.6	14.7
						COMB	50.8	51.0	47.5	42.5
						JET	57.6	58.0	53.9	47.9
						ATUR	46.6	47.3	38.1	36.2
						TOTL	62.6	65.0	55.3	50.8
2.0	10179.3	533.5	3204.3	10.5	9.5	FANI	57.5	59.8	45.5	46.4
						FAND	26.1	26.5	14.1	15.1
						COMB	51.4	51.7	47.9	43.1
						JET	58.2	58.7	54.3	48.5
						ATUR	47.4	48.0	38.7	36.9
						TOTL	63.4	65.7	55.7	51.4
2.5	10052.9	526.8	3078.6	10.8	9.8	FANI	58.5	60.8	46.4	47.3
						FAND	26.8	28.0	14.6	15.6
						COMB	52.1	52.5	48.4	43.8
						JET	58.9	59.4	54.7	49.1
						ATUR	48.2	48.9	39.3	37.6
						TOTL	64.3	66.5	56.2	52.2

3.0	9926.4	520.2	2952.9	11.1	10.1	FANI	59.4	61.8	47.4	48.2
						FAND	27.6	29.2	15.2	16.2
						COMB	52.8	53.2	48.9	44.4
						JET	59.6	60.1	55.1	49.7
						ATUR	49.1	49.7	39.9	38.4
						TOTL	65.1	67.4	56.7	52.9
3.5	9800.0	513.6	2827.3	11 4	10.4	FANI	60.4	62.8	48.4	49.2
						FAND	28.4	30.4	16.0	16.9
						COMB	53.5	53.9	49.4	45.2
						JET	60.3	60.8	55.5	50.3
						ATUR	49.9	50.6	40.5	39.1
						TOTL	65.9	68.2	57.2	53.7
4.0	9673.6	507.0	2701.8	11.7	10.7	FANI	61.4	63.7	49.4	50.3
						FAND	29.5	31.7	16.8	17.8
						COMB	54.3	54.5	50.0	45.9
						JET	61.1	61.5	56.0	51.0
						ATUR	50.8	51.4	41.2	39.9
						TOTL	66.8	69.0	57.8	54.5
4.5	9547.2	500.3	2576.4	12.1	11.1	FANI	62.6	64.8	50.5	51.3
						FAND	30.7	33.0	17.7	18.7
						COMB	55.0	55.2	50.7	46.7
						JET	61.8	62.2	56.5	51.7
						ATUR	51.8	52.3	42.0	40.8
						TOTL	67.7	69.9	58.4	55.4
5.0	9420.7	493.7	2451.2	12.5	11.5	FANI	64.0	66.2	51.6	52.5
						FAND	32.0	34.4	18.8	19.7
						COMB	55.8	56.0	51.4	47.6
						JET	62.6	63.0	57.0	52.5
						ATUR	52.8	53.3	42.7	41.7
						TOTL	68.8	71.0	59.0	56.3
5.5	9294.3	487.1	2326.0	13.0	12.0	FANI	65.4	67.7	52.8	53.7
						FAND	33.4	35.9	20.1	20.9
						COMB	56.6	56.9	52.1	48.4
						JET	63.4	63.8	57.6	53.2
						ATUR	53.8	54.4	43.6	42.6
						TOTL	70.1	72.3	59.8	57.3
6.0	9167.9	480.5	2201.1	13.5	12.5	FANI	66.8	69.0	54.0	54.9
						FAND	34.8	37.2	21.3	22.2
						COMB	57.6	57.9	52.9	49.4
						JET	64.2	64.5	58.2	54.0
						ATUR	55.0	55.5	44.4	43.5
						TOTL	71.3	73.4	60.5	58.3

6.5	9041.5	473.8	2076.3	14.1	13.1	FANI	68.3	70.4	55.3	56.1
						FAND	36.3	38.6	22.7	23.6
						COMB	58.6	58.9	53.8	50.3
						JET	64.9	65.3	58.8	54.8
						ATUR	56.1	56.6	45.3	44.5
						TOTL	72.5	74.6	61.4	59.3
7.0	8915.0	467.2	1951.8	14.7	13.7	FANI	69.8	72.0	56.6	57.5
						FAND	37.9	40.2	24.2	25.0
						COMB	59.7	59.9	54.7	51.3
						JET	65.9	66.2	59.5	55.7
						ATUR	57.3	57.8	46.3	45.6
						TOTL	73.9	76.0	62.3	60.4
7.5	8788.6	460.6	1827.6	15.5	14.5	FANI	71.4	73.5	58.1	58.9
						FAND	39.6	41.9	25.9	26.7
						COMB	60.8	60.9	55.7	52.3
						JET	66.9	67.2	60.2	56.5
						ATUR	58.6	59.0	47.3	46.7
						TOTL	75.3	77.4	63.2	61.6
8.0	8662.2	454.0	1703.7	16.3	15.3	FANI	72.9	75.0	59.5	60.3
						FAND	41.4	43.6	27.6	28.4
						COMB	61.8	62.1	56.7	53.2
						JET	67.9	68.1	60.9	57.4
						ATUR	59.8	60.2	48.4	47.8
						TOTL	76.7	78.7	64.2	62.8
8.5	8535.7	447.3	1580.2	17.3	16.3	FANI	74.6	76.8	61.0	61.8
						FAND	43.3	45.6	29.5	30.2
						COMB	62.9	63.1	57.8	54.2
						JET	68.8	69.1	61.7	58.2
						ATUR	61.3	61.7	49.5	49.0
						TOTL	78.3	80.3	65.3	64.0
9.0	8409.3	440.7	1457.3	18.4	17.4	FANI	76.2	78.3	62.5	63.2
						FAND	45.3	47.5	31.5	32.2
						COMB	64.0	64.3	58.9	55.2
						JET	69.7	69.9	62.5	59.1
						ATUR	62.7	63.1	50.7	50.3
						TOTL	79.8	81.8	66.5	65.3
9.5	8282.9	434.1	1335.1	19.8	18.8	FANI	77.8	79.1	63.9	64.5
						FAND	47.5	49.6	33.7	34.4
						COMB	65.4	65.6	60.1	56.3
						JET	70.9	71.0	63.4	60.0
						ATUR	64.4	64.8	52.0	51.7
						TOTI	81.2	82.5	67.6	66.4

10.0	8156.5	427.5	1213.7	21.4	20.4	FANI	77.8	79.7	63.9	64.4
						FAND	49.9	51.9	36.1	36.7
						COMB	66.7	66.9	61.3	57.3
						JET	72.1	72.2	64.3	61.0
						ATUR	66.2	66.5	53.5	53.3
						TOTL	81.5	83.4	68.3	66.8
10.5	8030.0	420.8	1093.6	23.4	22.4	FANI	77.7	79.6	63.8	64.3
						FAND	52.5	54.6	38.8	39.4
						COMB	67.9	68.1	62.6	58.6
						JET	73.2	73.4	65.5	62.2
						ATUR	68.1	68.5	55.2	55.0
						TOTL	81.8	83.1	69.1	67.3
11.0	7903.6	414.2	975.1	25.9	24.9	FANI	79.0	80.2	65.1	65.6
						FAND	55.4	56.7	41.8	42.3
						COMB	68.9	69.1	64.1	60.0
						JET	74.2	74.3	66.8	63.5
						ATUR	70.2	70.5	57.1	56.9
						TOTL	83.2	84.4	70.5	68.7
11.5	7777.2	407.6	858.9	29.0	28.0	FANI	79.4	80.7	65.6	66.1
						FAND	58.8	60.0	45.2	45.6
						COMB	70.2	70.4	65.7	61.6
						JET	75.7	75.8	68.3	64.9
						ATUR	72.4	72.7	59.1	59.0
						TOTL	84.1	85.2	71.7	69.7
12.0	7650.8	401.0	746.1	33.1	32.1	FANI	78.1	79.4	64.3	64.9
						FAND	62.6	63.8	49.1	49.4
						COMB	72.5	72.6	67.5	63.3
						JET	77.5	77.6	69.8	66.4
						ATUR	74.8	75.1	61.4	61.3
						TOTL	84.2	85.1	72.9	70.4
12.5	7524.3	394.3	638.5	38.7	37.7	FANI	76.3	77.5	62.6	63.1
						FAND	67.1	68.2	53.7	53.9
						COMB	74.5	74.6	69.8	65.5
						JET	79.2	79.3	71.7	68.1
						ATUR	77.4	77.6	64.0	63.8
						TOTL	84.9	85.6	74.6	71.7
13.0	7397.9	387.7	539.3	46.4	45.4	FANI	73.4	74.6	59.7	60.2
						FAND	72.3	73.3	59.1	59.2
						COMB	77.8	77.9	72.2	67.8
						JET	81.4	81.5	73.5	69.9
						ATUR	80.1	80.3	66.8	66.6
						TOTL	86.5	87.0	76.6	73.5

13.5	7271.5	381.1	453.8	57.2	56.2	FANI	69.4	70.4	55.9	56.2
						FAND	78.4	79.2	65.6	65.6
						COMB	79.5	79.6	74.7	70.2
						JET	83.4	83.5	75.5	71.9
						ATUR	82.9	83.1	69.8	69.5
						TOTL	89.2	89.6	79.0	75.9
14.0	7145.1	374.5	391.3	72.2	71.2	FANI	64.9	67.0	51.6	51.7
						FAND	86.1	87.0	73.2	73.3
						COMB	81.6	81.7	76.7	71.9
						JET	85.5	85.6	77.4	73.8
						ATUR	85.5	85.6	72.5	72.3
						TOTL	93.1	93.6	81.5	78.9
14.5	7018.6	367.8	363.2	91.1	89.9	FANI	57.5	60.2	44.7	44.7
						FAND	92 1	93.0	79.1	79.3
						COMB	83.9	84.0	79.1	73.9
						JET	87.2	87.2	78.9	75.3
						ATUR	87.8	87.9	75.0	74.7
						TOTL	97.0	97.7	84.4	82.4
15.0	6892.2	361.2	379.0	110.5	70.5	FANI	46.6	48.2	33.7	33.8
						FAND	93.9	94.5	80.9	81.2
						COMB	84.6	84.7	80.0	74.3
						JET	87.7	87.7	79.5	75.9
						ATUR	93.1	93.2	80.2	80.0
						TOTL	99.2	99.6	86.2	84.7
15.5	6765.8	354.6	432.5	126.8	54.2	FANI	35.7	37.0	22.6	22.8
						FAND	92.4	92.7	79.5	79.9
						COMB	82.8	82.9	78.8	72.8
						JET	85.3	85.4	79.1	73.4
						ATUR	88.2	88.3	75.2	75.0
						TOTL	96.9	97.2	84.5	82.3
16.0	6639.4	347.9	512.3	138.8	42.2	FANI	29.7	32.5	16.4	17.0
						FAND	88.4	88.9	75.4	75.8
						COMB	80.9	81.1	76.9	70.7
						JET	82.8	82.9	77.1	70.0
						ATUR	80.8	80.9	67.7	67.6
						TOTL	93.0	93.4	81.5	78.2
16.5	6512.9	341.3	608.2	147.3	33.7	FANI	26.4	27.3	13.9	14.8
						FAND	83.1	83.8	69.8	70.4
						COMB	78.8	79.0	75.0	68.8
						JET	79.7	79.9	74.0	66.8
						ATUR	75.0	75.1	61.7	61.7
						TOTL	88.6	89.2	78.3	73.9

17.0	6386.5	334.7	713.7	153.4	27.6	FANI	24.2	24.2	13.0	14.0
						FAND	78.6	79.3	65.2	65.7
						COMB	77.0	77.2	72.9	67.0
						JET	76.3	76.4	70.6	63.6
						ATUR	70.9	71.1	57.6	57.6
						TOTL	85.0	85.6	75.4	70.7
17.5	6260.1	328.1	825.2	157.9	23.1	FANI	24.2	24.2	13.0	14.0
						FAND	74.8	75.6	61.2	61.9
						COMB	75.2	75.4	71.0	65.4
						JET	73.2	73.3	67.9	60.4
						ATUR	67.8	68.0	54.5	54.6
						TOTL	81.9	82.6	73.1	68.0
18.0	6133.6	321.4	940.5	161.3	19.7	FANI	24.2	24.2	13.0	14.0
						FAND	71.6	72.4	57.9	58.6
						COMB	73.9	74.2	69.2	63.9
						JET	70.8	71.0	66.1	57.9
						ATUR	65.1	65.4	51.9	51.9
						TOTL	79.7	80.4	71.2	65.9
18.5	6007.2	314.8	1058.4	163.9	17.1	FANI	24.2	24.2	13.0	14.0
						FAND	68.7	69.5	55.0	55.7
						COMB	72.3	72.6	67.7	62.5
						JET	68.7	68.8	65.0	55.8
						ATUR	62.8	63.0	49.5	49.6
						TOTL	77.6	78.3	69.8	64.2
19.0	5880.8	308.2	1178.2	166.0	15.0	FANI	24.2	24.2	13.0	14.0
						FAND	66.1	66.9	52.4	53.2
						COMB	70.7	71.0	66.5	61.1
						JET	67.2	67.4	64.0	54.1
						ATUR	60.6	60.9	47.5	47.5
						TOTL	75.7	76.3	68.6	62.6
19.5	5754.4	301.6	1299.2	167.8	13.2	FANI	24.2	24.2	13.0	14.0
						FAND	63.8	64.6	50.1	50.9
						COMB	69.2	69.5	65.4	59.7
						JET	65.8	66.0	63.2	52.6
						ATUR	58.7	58.9	45.6	45.6
						TOTL	73.9	74.6	67.6	61.0
20.0	5627.9	294.9	1421.2	169.2	11.8	FANI	24.2	24.2	13.0	14.0
						FAND	61.7	62.6	48.0	48.8
						COMB	67.6	67.9	64.7	58.2
						JET	64.5	64.7	62.5	51.2
						ATUR	56.9	57.2	43.9	43.8
						TOTL	72.2	72.9	66.8	59.5

20.5	5501.5	288.3	1543.9	170.4	10.6	FANI	24.2	24.2	13.0	14.0
						FAND	59.7	60.6	46.0	46.8
						COMB	66.4	66.5	64.1	57.0
						JET	63.3	63.6	61.8	50.1
						ATUR	55.2	55.4	42.3	42.2
						TOTL	70.8	71.6	66.1	58.3
21.0	5375.1	281.7	1667.2	171.4	9.6	FANI	24.2	24.2	13.0	14.0
						FAND	57.9	58.7	44.2	45.1
						COMB	65.9	66.1	63.6	56.0
						JET	62.3	62.5	61.1	49.2
						ATUR	53.6	53.8	40.8	40.6
						TOTL	70.0	70.7	65.6	57.2
21.5	5248.7	275.1	1791.0	172.3	8.7	FANI	24.2	24.2	13.0	14.0
						FAND	56.1	56.9	42.5	43.4
						COMB	65.4	65.6	63.2	55.3
						JET	61.3	61.6	60.4	48.4
						ATUR	52.0	52.3	39.5	39.1
						TOTL	69.3	69.9	65.1	56.4
22.0	5122.2	268.4	1915.1	173.1	7.9	FANI	24.2	24.2	13.0	14.0
						FAND	54.6	55.6	41.0	41.9
						COMB	64.9	65.2	62.9	54.8
						JET	60.4	60.7	59.8	47.7
						ATUR	50.7	51.0	38.3	37.8
						TOTL	68.5	69.3	64.6	55.8
22.5	4995.8	261.8	2039.6	173.7	7.3	FANI	24.2	24.2	13.0	14.0
						FAND	53.1	54.1	39.6	40.5
						COMB	64.5	64.7	62.5	54.4
						JET	59.6	59.8	59.2	47.0
						ATUR	49.4	49.8	37.2	36.6
						TOTL	67.9	68.7	64.2	55.3
23.0	4869.4	255.2	2164.2	174.3	6.7	FANI	24.2	24.2	13.0	14.0
						FAND	51.4	52.2	38.1	39.0
						COMB	64.0	64.3	62.2	54.0
						JET	58.9	59.1	58.6	46.5
						ATUR	48.0	48.4	36.2	35.4
						TOTL	67.3	67.9	63.8	54.9
23.5	4743.0	248.6	2289.1	174.9	6.1	FANI	24.2	24.2	13.0	14.0
						FAND	50.0	50.7	36.8	37.7
						COMB	63.6	64.0	61.9	53.7
						JET	58.2	58.4	58.0	45.9
						ATUR	46.8	47.2	35.4	34.3
						TOTL	66.7	67.3	63.4	54.5

24.0	4616.5	241.9	2414.2	175.3	5.7	FANI	24.2	24.2	13.0	14.0
						FAND	48.8	49.7	35.6	36.5
						COMB	63.2	63.4	61.5	53.5
						JET	57.5	57.7	57.5	45.4
						ATUR	45.8	46.2	34.6	33.3
						TOTL	66.1	66.8	63.0	54.2
24.5	4490.1	235.3	2539.5	175.8	5.2	FANI	24.2	24.2	13.0	14.0
						FAND	47.7	48.8	34.4	35.3
						COMB	62.8	63.0	61.2	53.2
						JET	56.9	57.1	56.9	44.9
						ATUR	44.8	45.3	33.8	32.3
						TOTL	65.6	66.5	62.6	53.9
25.0	4363.7	228.7	2664.8	176.2	4.8	FANI	24.2	24.2	13.0	14.0
						FAND	46.5	47.6	33.3	34.2
						COMB	62.4	62.5	60.8	52.9
						JET	56.3	56.4	56.4	44.4
						ATUR	43.8	44.4	33.2	31.4
						TOTL	65.0	66.0	62.2	53.5
25.5	4237.2	222.1	2790.3	176.5	4.5	FANI	24.2	24.2	13.0	14.0
						FAND	45.1	46.2	32.2	33.0
						COMB	61.9	62.1	60.4	52.6
						JET	55.7	55.9	55.9	43.9
						ATUR	42.7	43.2	32.5	30.6
						TOTL	64.5	65.3	61.7	53.2
26.0	4110.8	215.4	2915.9	176.8	4.2	FANI	24.2	24.2	13.0	14.0
						FAND	43.8	44.7	31.1	31.9
						COMB	61.5	61.7	60.0	52.2
						JET	55.1	55.3	55.4	43.5
						ATUR	41.6	42.0	31.9	29.8
						TOTL	64.0	64.6	61.3	52.8
26.5	3984.4	208.8	3041.5	177.1	3.9	FANI	24.2	24.2	13.0	14.0
						FAND	42.6	43.4	30.1	30.9
						COMB	61.1	61.3	59.7	51.9
						JET	54.5	54.7	54.9	43.0
						ATUR	40.8	41.2	31.3	29.0
						TOTL	63.4	64.0	60.9	52.5
27.0	3858.0	202.2	3167.2	177.4	3.6	FANI	24.2	24.2	13.0	14.0
						FAND	41.5	42.3	29.1	29.9
						COMB	60.6	60.9	59.3	51.5
						JET	54.0	54.2	54.4	42.5
						ATUR	40.0	40.5	30.7	28.3
						TOTL	62.9	63.5	60.5	52.1

27.5	3731.5	195.6	3293.0	177.7	3.3	FANI	24.2	24.2	13.0	14.0
						FAND	40.5	41.4	28.2	28.9
						COMB	60.2	60.5	58.9	51.2
						JET	53.4	53.6	53.9	42.[illegible]
						ATUR	39.2	39.8	30.2	27.6
						TOTL	62.4	63.1	60.1	51.7
28.0	3605.1	188.9	3418.9	177.9	3.1	FANI	24.2	24.2	13.0	14.0
						FAND	39.6	40.6	27.3	2[illegible] 0
						COMB	5[illegible].8	60.1	58.5	50.8
						JET	52.9	53.0	53.4	41.6
						ATUR	38.3	39.0	29.7	27.0
						TOTL	61.9	62.6	59.6	51.3
28.5	3478.7	182.3	3544.8	178.1	2.9	FANI	24.2	24.2	13.0	14.0
						FAND	38.7	39.8	26.4	27.1
						COMB	59.4	59.5	58.1	50.4
						JET	52.4	52.5	53.0	41.1
						ATUR	37.5	38.0	29.2	26.3
						TOTL	61.4	62.2	59.2	50.9
29.0	3352.3	175.7	3670.8	178.3	2.7	FANI	24.2	24.2	13.0	14.0
						FAND	37.8	38.9	25.6	26.2
						COMB	58.9	59.0	57.6	50.0
						JET	51.9	52.0	52.5	40.7
						ATUR	36.7	37.1	28.6	25.7
						TOTL	60.9	61.7	58.8	50.5
29.5	3225.8	169.1	3796.8	178.5	2.5	FANI	24.2	24.2	13.0	14.0
						FAND	36.8	37.9	24.7	25.3
						COMB	58.5	58.6	57.2	49.6
						JET	51.4	51.5	52.0	40.2
						ATUR	35.8	36.3	28.1	25.1
						TOTL	60.4	61.2	58.4	50.1
30.0	3099.4	162.4	3922.8	178.7	2.3	FANI	24.2	24.2	13.0	14.0
						FAND	35.8	36.9	24.0	24.5
						COMB	58.0	58.2	56.8	49.2
						JET	50.9	51.0	51.6	39.8
						ATUR	35.0	35.4	27.7	24.5
						TOTL	59.9	60.7	58.0	49.7
30.5	2973.0	155.8	4048.9	178.9	2.[illegible]	FANI	24.2	24.2	13.0	14.0
						FAND	34.9	35.9	23.2	23.8
						COMB	57.6	57.7	56.4	48.8
						JET	50.4	50.5	51.1	39.3
						ATUR	34.2	34.6	27.2	24.0
						TOTL	59.5	60.2	57.5	49.3

31.0	2846.6	149.2	4175.0	179.0	2.0	FANI	24.2	24.2	13.0	14.0
						FAND	33.9	35.0	22.5	23.0
						COMB	57.2	57.3	56.0	48.4
						JET	49.9	50.0	50.7	38.8
						ATUR	33.5	33.9	26.7	23.5
						TOTL	59.0	59.6	57.1	48.9
31.5	2720.1	142.6	4301.1	179.2	1.8	FANI	24.2	24.2	13.0	14.0
						FAND	33.0	34.1	21.9	22.3
						COMB	56.7	56.9	55.6	47.9
						JET	49.4	49.5	50.2	38.4
						ATUR	32.8	33.1	26.2	22.9
						TOTL	58.5	59.1	56.7	48.4
32.0	2593.7	135.9	4427.3	179.3	1.7	FANI	24.2	24.2	13.0	14.0
						FAND	32.1	33.2	21.2	21.7
						COMB	56.3	56.4	55.1	47.5
						JET	48.9	49.1	49.8	37.9
						ATUR	32.3	32.4	25.7	22.4
						TOTL	58.0	58.5	56.2	48.0
32.5	2467.3	129.3	4553.4	179.4	1.6	FANI	24.2	24.2	13.0	14.0
						FAND	31.3	32.3	20.6	21.1
						COMB	55.8	56.0	54.7	47.1
						JET	48.4	48.6	49.3	37.4
						ATUR	31.8	31.9	25.2	21.9
						TOTL	57.6	57.9	55.8	47.5
33.0	2340.9	122.7	4679.7	179.5	1.5	FANI	24.2	24.2	13.0	14.0
						FAND	30.7	31.5	20.1	20.5
						COMB	[illegible]	55.5	54.2	[illegible]
						JET	47.9	[illegible]	48.9	37.0
						ATUR	31.3	31.4	24.7	21.4
						TOTL	57.1	57.3	55.3	47.1
33.5	2214.4	116.1	4805.9	179.7	1.3	FANI	24.2	24.2	13.0	14.0
						FAND	30.2	30.8	19.5	19.9
						COMB	54.9	55.0	53.8	46.1
						JET	47.4	47.6	48.4	36.5
						ATUR	30.8	31.0	24.3	20.9
						TOTL	56.6	56.7	54.9	46.6
34.0	2088.0	109.4	4932.1	179.8	1.2	FANI	24.2	24.2	13.0	14.0
						FAND	29.6	30.1	18.9	19.4
						COMB	54.4	54.6	53.3	45.7
						JET	46.9	47.1	47.9	36.0
						ATUR	30.3	30.5	23.8	20.4
						TOTL	56.1	56.2	54.4	46.1

34.5	1961.6	102.8	5058.4	1[illegible]9.9	1.1	FANI	24.2	24.2	13.0	14.0
						FAND	29.1	29.4	18.4	18.9
						COMB	53.9	54.1	52.8	45.2
						JET	46.4	46.6	47.4	35.5
						ATUR	29.8	30.0	23.3	19.9
						TOTL	55.6	55.7	53.9	45.6
35.0	1835.1	96.2	5184.7	180.0	1.0	FANI	24.2	24.2	13.0	14.0
						FAND	28.5	28.8	17.9	18.4
						COMB	53.4	53.6	52.3	44.7
						JET	45.8	46.0	46.9	35.0
						ATUR	29.4	29.6	22.7	19.4
						TOTL	55.1	55.2	53.4	45.1
35.5	1708.7	89.5	5311.0	179.9	0.9	FANI	24.2	24.2	13.0	14.0
						FAND	28.0	28.3	17.4	17.9
						COMB	52.9	53.1	51.8	44.1
						JET	45.3	45.5	46.4	34.5
						ATUR	28.9	29.1	22.2	19.0
						TOTL	54.6	54.6	52.9	44.6
36.0	1582.3	82.9	5437.3	179.8	0.8	FANI	24.2	24.2	13.0	14.0
						FAND	27.6	27.8	17.0	17.5
						COMB	52.3	52.5	51.3	43.6
						JET	44.8	45.0	45.9	34.0
						ATUR	28.5	28.7	21.7	18.5
						TOTL	54.0	54.1	52.4	44.1
36.5	1455.9	76.3	5563.6	179.7	0.7	FANI	24.2	24.2	13.0	14.0
						FAND	27.1	27.4	16.6	17.1
						COMB	51.8	52.0	50.7	43.0
						JET	44.3	44.5	45.4	33.4
						ATUR	28.1	28.3	21.2	18.1
						TOTL	53.5	53.6	51.9	43.5
37.0	1329.4	69.7	5689.9	179.7	0.7	FANI	24.2	24.2	13.0	14.0
						FAND	26.6	26.9	16.1	16.7
						COMB	51.2	51.4	50.2	42.4
						JET	43.7	43.9	44.9	32.9
						ATUR	27.6	27.8	20.7	17.6
						TOTL	52.9	53.0	51.3	42.9
37.5	1203.0	63.0	5816.3	179.6	0.6	FANI	24.2	24.[illegible]	13.0	14.0
						FAND	26.2	26.5	15.8	16.3
						COMB	50.6	50.8	49.5	41.8
						JET	43.1	43.3	44.3	32.3
						ATUR	27.3	27.5	20.1	17.2
						TOTL	52.3	52.4	50.7	42.3

38.0	1076.6	56.4	5942.6	179.5	0.5	FANI	24.2	24.2	13.0	14.0
						FAND	25.0	26.0	15.4	16.0
						COMB	49.9	50.1	48.9	41.1
						JET	42.5	42.7	43.6	31.6
						ATUR	27.0	27.2	19.5	16.7
						TOTL	51.7	51.7	50.0	41.6
38.5	950.2	49.8	6069.0	179.4	0.4	FANI	24.2	24.2	13.0	14.0
						FAND	25.4	25.7	15.1	15.7
						COMB	49.2	49.4	48.2	40.4
						JET	41.8	41.9	43.0	31.0
						ATUR	26.8	27.0	18.9	16.3
						TOTL	51 [illegible]	51.1	49.3	47.9
39.0	823.7	43.2	6195.4	179.4	0.4	FANI	24.2	24.2	13.0	14.0
						FAND	25.1	25.4	14.8	.5.5
						COMB	48.5	48.7	47.4	39.6
						JET	41.1	41.2	42.2	30.2
						ATUR	26.5	26.7	18.3	16.0
						TOTL	50.3	50.3	48.5	40.1
39.5	697.3	36.5	6321.8	179.3	0.3	FANI	24.2	24.2	13.0	14.0
						FAND	25.0	25.3	14.5	15.3
						COMB	47.7	47.9	46.6	38.8
						JET	40.3	40.3	41.4	29.4
						ATUR	26.2	26.4	17.7	15.6
						TOTL	49.5	49.6	47.7	39.3
40.0	573.9	29.9	6448.2	179.2	0.2	FANI	24.2	24.2	13.0	14.0
						FAND	24.9	25.2	14.3	15.1
						COMB	46.9	47.1	45.7	38.0
						JET	39.5	39.5	40.6	28.4
						ATUR	25.9	26.2	17.0	15.3
						TOTL	48.7	48.8	46.9	38.5
40.5	444.5	23.3	6574.6	179.2	0.2	FANI	24.2	24.2	13.0	14.0
						FAND	24.8	25.1	14.2	14.9
						COMB	46.0	46.3	44.8	37.1
						JET	38.7	38.7	39.7	27.8
						ATUR	25.7	25.9	16.4	15.1
						TOTL	47.9	48.0	45.9	37.6
41.0	318.0	16.7	6701.0	179.1	0.1	FANI	24.2	24.2	13.0	14.0
						FAND	24.7	25.0	14.0	14.8
						COMB	45.2	45.5	43.9	36.2
						JET	37.9	37.9	38.8	26.9
						ATUR	25.5	25.6	15.9	14.9
						TOTL	47.1	47.2	45.0	36.8

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41.5	191.6	10.0	6827.4	179.1	0.1	FANI	24.2	24.2	13.0	14.0
						FAND	24.7	25.0	14.0	14.7
						COMB	44.5	44.8	43.1	35.5
						JET	37.2	37.2	38.0	26.2
						ATUR	25.3	25.4	15.5	14.9
						TOTL	46.4	46.5	44.3	36.1
42.0	65.2	3.4	6953.8	179.0	-0.0	FANI	24.2	24.2	13.0	14.0
						FAND	24.7	25.0	14.0	14.7
						COMB	44.1	44.4	42.6	35.1
						JET	36.8	36.8	37.6	25.8
						ATUR	25.2	25.3	15.3	14.9
						TOTL	46.1	46.1	43.8	30.7

TFE731/LEAR36 APPROACH SIMULATION FLYOVER NOISE PREDICTION

AIRCRAFT NOISE LEVEL PREDICTIONS AT MINIMUM SLANT DISTANCE

TIME SEC	RANGE FEET	ALTITUDE FEET	SLANT DIST,FT	ENGINE-OBSERVER ANGLE,DEG	ELEV ANGLE DEG	COMPONENT	PNL DB	PNLTC DB	OVERALL DB	A-WEIGHTED DB(A)
14.5	7018.6	367.8	363.8	91.1	89.9	FANI	57.5	60.2	44.7	44.7
						FAND	92.1	93.0	79.1	79.3
						COMB	83.9	84.0	7[illegible].1	73.9
						JET	87.2	87.2	78.9	75.3
						ATUR	87.8	87.9	75.0	74.7
						TOTL	97.0	97.7	84.4	82.4

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NASA GASP NOISE MODULE OUTPUT

TFE731/LEAR36 APPROACH SIMULATION FLYOVER NOISE PREDICTION

SUMMARY OUTPUT OF PREDICTED NOISE LEVELS

COMPONENT	EPNL DB	MAX PNLTC DB	TIME AT MAX PNLTC	ANGLE,DEG MAX PNLTC	DUR CORR	DUR TIME	MAX PNL	TIME AT MAX PNL	ANGLE,DEG MAX PNL	MAX OVERALL DB	TIME AT MAX OVERALL	MAX A-WEIGHTED DB	TIME AT MAX A-WEIGHTED
FANI	76.4	80.8	11.5	29.0	-4.4	7.0	79.4	11.5	29.0	65.6	11.5	66.1	11.5
FAND	86.2	94.5	15.0	110.5	-8.4	3.0	93.9	15.0	110.5	80.9	15.0	81.2	15.0
COMB	78.4	84.7	15.0	110.5	-6.3	5.5	84.6	15.0	110.5	80.0	15.0	74.3	15.0
JET	81.3	87.8	15.0	110.5	-6.5	5.0	87.7	15.0	110.5	79.5	15.0	75.9	15.0
ATUR	83.1	93.2	15.0	110.5	-10.1	2.5	93.1	15.0	110.5	80.2	15.0	80.0	15.0
TOTL	91.2	99.7	15.0	110.5	-8.4	3.0	99.2	15.0	110.5	86.2	15.0	84.7	15.0

FAR36 STAGE 3 NOISE LIMIT FOR INPUT AIRCRAFT IS 98.0 EPN(DB)

*****FLYOVER AIRCRAFT NOISE PREDICTION CASE COMPLETED*****

*****PSEUDOTONES BELOW 1000 HZ WERE ELIMINATED PER FAA FAR36, B36.5.M , (IPSEUD=1).
*****FLYOVER NOISE LEVELS INCLUDE A DOPPLER SHIFT.

```
******************************************************************************************************************************
                          TFE731/LEAR36 APPROACH SIMULATION FLYOVER NOISE PREDICTION
******************************************************************************************************************************
++++++++++INPUT VARIABLE STATUS AT JOB END+++++
++++++++++INPUT VARIABLE STATUS AT JOB END+++++
                                   INPUT DATA - USER INPUT AND DEFAULT VALUES USED
******************************************************************************************************************************
CONTROL VARIABLES  *
********************

IFAA= 1   APPROACH,     IPOUT= 3   FULL     ,               ISTAG= 3            ICAB= 0             ISI= 0  (ENGL UNITS)

***********************
ENVIRONMENTAL VARIABLES*
***********************

TAMB=536.7          PAMB= 2116.2        RH= 70.             DIST= 100.0         NLOC= 16

ANGLE (ARRAY) =  10.0  20.0  30.0  40.0  50.0  60.0  70.0  80.0  90.0 100.0 110.0 120.0 130.0 140.0 150.0 160.0


***********************
ENGINE/AIRCRAFT SYSTEM *
***********************

+++++ENGINE VARIABLES+++++
ENGINE TYPE(NTYE)= 1  (FAN )  .......................ENGINE COMPONENT ARRAY(ICOMP) =    1    4    5    6    0    0
                                                                                        FAN  COMB JET  ATUR NONE NONE

+++++AIRFRAME VARIABLES+++++
AMACH=0.22          VEL= 253.2          ENP= 2.             ANENGI=  0.0        ANENGE=  0.0        XL=  5.5
YL=  2.6            ZL= 16.7            WGMAX= 17000.       LOCENG= 1           IPHASE= 0           IDOP= 1

****************
FLIGHT PROFILE *
****************

IDPRO= 0                                VEL= 253.2          AMACH=0.22          FLTANG= 3.0         ANGAFT= 4.0
TOROLL=    0.       APDIST=10685.0      XALT=1000.

*****A STRAIGHT LINE PROFILE WILL BE COMPUTED FROM A COMBINATION OF THE ABOVE VARIABLES.

****************
FLIGHT OPTIONS *
****************

KGOLD=  0           XLSIDE=     0.0     XRSIDE=     0.0     IQS=  1             ICUT=  0            IPSEUD=  1
IDUR= 0             XTOL= 100.          IWING= 0
XFAA= 7019.,21325.,21325.,    0.,       YFAA=    4.,    4.,    4.,    4.,       ZFAA=    0.,    0., 1476.,    0.,
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                                        NASA LEWIS RESEARCH CENTER                               PAGE  14
                                        NASA GASP NOISE MODULE OUTPUT
**********************************************************************************************************************************
                         TFE731/LEAR36 APPROACH SIMULATION FLYOVER NOISE PREDICTION
**********************************************************************************************************************************
++++++++++INPUT VARIABLE STATUS AT JOB END+++++
++++++++++INPUT VARIABLE STATUS AT JOB END+++++
************************************
ENGINE COMPONENT VARIABLES AT INPUT*
************************************

+++++FAN +++++
IGV= 0              IFD= 0              NH= 8               NSTG= 1             NBF= 30             NVAN=109
RSS=200.00          WAFAN= 79.18        RPM=  8391.         DELT= 45.50         FPR= 0.0            FANDIA= 2.3190
FANHUB= 1.1250      TIPMD=1.4800        TIPM=0.9549         FANEFF=0.0          NBF2=  0            NVAN2=  0
FAND2= 0.0          TIPMD2=0.0          TIPM2=0.0           RSS2=100.00         PRAT= 0.0           TRAT=0.0
FANEF2=0.0          IBUZ= 0             ITONE= 0            AMACH=0.2229        CAEF= 40.0

+++++COMB+++++
WACOMB=  17.35      T3=1036.0           T4=1875.0           P3= 14472.0         CAEC= 20.0
AMACH=0.223

+++++JET +++++
VJ= 791.7           TJ=1254.7           DJ= 0.9594          HJ=0.47970          GAMJ=1.3330         VJ2= 692.1
TJ2= 587.2          DJ2= 1.6292         HJ2=0.33490         GAMJ2=1.4010        EL2=  0.78          ALFAJ= 0.0
PHIJ= 0.0           VO= 253.2           INVOPT= 0

+++++ATUR+++++
RPMT= 15094.0       DT= 1.266           DH= 0.745           ACNZ= 0.824         NBT= 80             DTOT=0.35000
PRTS= 0.0           GAMAT=1.37300       CAET= 40.0          AMACH=0.223

***** A DOPPLER FREQUENCY SHIFT WILL BE APPLIED TO ALL SOURCE STATIC SPECTRA AS A FUNCTION OF FLIGHT MACH NO. AND ANGLE FROM INLET.
```

APPENDIX A

Sample Test Case 2

Takeoff Condition for a Turbofan Powered Executive Aircraft

```
                                                    NASA LEWIS RESEARCH CENTER                                PAGE   1
                                                   NASA GASP NOISE MODULE OUTPUT
*****************************************************************************************************************************
                         LEAR36/TFE731 NOISE PREDICTION AT FAR36 TAKEOFF CONDITION
*****************************************************************************************************************************
                                              INPUT DATA - USER INPUT AND DEFAULT VALUES USED
*****************************************************************************************************************************
CONTROL VARIABLES  *
********************

IFAA= 2   TAKEOFF ,     IPOUT= 3   FULL     ,                 ISTAG= 3            ICAB= 0             ISI= 0  (ENGL UNITS)

************************
ENVIRONMENTAL VARIABLES*
************************

TAMB=536.7          PAMB= 2116.2        RH= 70.             DIST= 100.0         NLOC= 16

ANGLE (ARRAY) =  10.0  20.0  30.0  40.0  50.0  60.0  70.0  80.0  90.0 100.0 110.0 120.0 130.0 140.0 150.0 160.0


************************
ENGINE/AIRCRAFT SYSTEM *
************************

+++++ENGINE VARIABLES+++++
ENGINE TYPE(NTYE)= 1  (FAN )  ........................ENGINE COMPONENT ARRAY(ICOMP) =     1    4    5    6    0    0
                                                                                        FAN  COMB JET  ATUR NONE NONE

+++++AIRFRAME VARIABLES+++++
AMACH=0.25          VEL= 288.2          ENP= 2.             ANENGI=  0.0        ANENGE=  0.0        XL=  5.5
YL=  2.6            ZL= 16.7            WGMAX= 17000.       LOCENG= 1           IPHASE= 0           IDOP= 1

****************
FLIGHT PROFILE *
****************

IDPRO= 0                                VEL= 288.2          AMACH=0.25          FLTANG=11.0         ANGAFT= 7.2
TOROLL= 4500.       APDIST=    0.0      XALT=1000.

*****A STRAIGHT LINE PROFILE WILL BE COMPUTED FROM A COMBINATION OF THE ABOVE VARIABLES.

****************
FLIGHT OPTIONS *
****************

KGOLD=  0           XLSIDE=     0.0     XRSIDE=     0.0     IQS=  1             ICUT=  0            IPSEUD=  1
IDUR= 1             XTOL= 100.          IWING= 0
XFAA= 7516.,21230.,21325.,    0.,       YFAA=    4.,    4.,    4.,    4.,       ZFAA=    0.,    0., 1476.,    0.,

*****THE FLIGHT PROFILE WILL BE TERMINATED WHEN THE OVERALL ENGINE PNLTC IS 10 DB BELOW ITS MAXIMUM VALUE (IDUR=1).
```

```
****************************************************************************************************************************
                         LEAR36/TFE731 NOISE PREDICTION AT FAR36 TAKEOFF CONDITION
****************************************************************************************************************************
*********************************
ENGINE COMPONENT VARIABLES AT INPUT*
*********************************

+++++FAN +++++
IGV= 0           IFD= 0           NH= 8            NSTG= 1          NBF= 30          NVAN=109
RSS=200.00       WAFAN=104.82     RPM= 11161.      DELT= 80.70      FPR= 0.0         FANDIA= 2.3190
FANHUB= 1.1250   TIPMD=1.4800     TIPM=0.0         FANEFF=0.0       NBF2=  0         NVAN2=  0
FAND2= 0.0       TIPMD2=0.0       TIPM2=0.0        RSS2=100.00      PRAT= 0.0        TRAT=0.0
FANEF2=0.0       IBUZ= 0          ITONE= 0         AMACH=0.2537     CAEF= 40.0

+++++COMB+++++
WACOMB=  28.85   T3=1269.0        T4=2287.4        P3= 27995.0      CAEC= 20.0
AMACH=0.254

+++++JET +++++
VJ=1509.0        TJ=1427.0        DJ= 0.9594       HJ=0.50000       GAMJ=1.3330      VJ2= 922.0
TJ2= 613.0       DJ2= 1.6292      HJ2=0.33490      GAMJ2=1.4010     EL2=  0.78       ALFAJ= 7.20
PHIJ= 0.0        V0= 288.2        INVOPT= 0

+++++ATUR+++++
RPMT= 20076.0    DT= 1.266        DH= 0.745        ACNZ= 0.824      NBT= 80          DTOT=0.45000
PRTS= 0.0        GAMAT=1.33300    CAET= 40.0       AMACH=0.254

***** A DOPPLER FREQUENCY SHIFT WILL BE APPLIED TO ALL SOURCE STATIC SPECTRA AS A FUNCTION OF FLIGHT MACH NO. AND ANGLE FROM INLET.
```

LEAR36/TFE731 NOISE PREDICTION AT FAR36 TAKEOFF CONDITION

FLIGHT PROFILE GENERATED FOR FLYOVER PREDICTIONS

VEL= 288.2 AMACH=0.254 TOROLL= 4500. APDIST= 0. XALT=1000. (FOR LEVEL FLYOVER)

TIME SECONDS	IPRO	RANGE FEET	ALTITUDE FEET	AIRCRAFT ANGLE OF ATTACK,DEG	FLIGHT ANGLE DEG
0.0	1	4500.0	0.0	7.2	11.0
0.5	2	4641.5	27.4	7.2	11.0
1.0	3	4782.9	54.8	7.2	11.0
1.5	4	4924.4	82.3	7.2	11.0
2.0	5	5065.9	109.7	7.2	11.0
2.5	6	5207.3	137.1	7.2	11.0
3.0	7	5348.8	164.5	7.2	11.0
3.5	8	5490.3	191.9	7.2	11.0
4.0	9	5631.7	219.4	7.2	11.0
4.5	10	5773.2	246.8	7.2	11.0
5.0	11	5914.7	274.2	7.2	11.0
5.5	12	6056.1	301.6	7.2	11.0
6.0	13	6197.6	329.1	7.2	11.0
6.5	14	6339.1	356.5	7.2	11.0
7.0	15	6480.5	383.9	7.2	11.0
7.5	16	6622.0	411.3	7.2	11.0
8.0	17	6763.5	438.7	7.2	11.0
8.5	18	6904.9	466.2	7.2	11.0
9.0	19	7046.4	493.6	7.2	11.0
9.5	20	7187.9	521.0	7.2	11.0
10.0	21	7329.3	548.4	7.2	11.0
10.5	22	7470.8	575.8	7.2	11.0
11.0	23	7612.3	603.3	7.2	11.0
11.5	24	7753.7	630.7	7.2	11.0
12.0	25	7895.2	658.1	7.2	11.0
12.5	26	8036.7	685.5	7.2	11.0
13.0	27	8178.1	712.9	7.2	11.0
13.5	28	8319.6	740.4	7.2	11.0
14.0	29	8461.1	767.8	7.2	11.0
14.5	30	8602.5	795.2	7.2	11.0
15.0	31	8744.0	822.6	7.2	11.0
15.5	32	8885.5	850.1	7.2	11.0
16.0	33	9026.9	877.5	7.2	11.0
16.5	34	9168.4	904.9	7.2	11.0
17.0	35	9309.9	932.3	7.2	11.0
17.5	36	9451.3	959.7	7.2	11.0
18.0	37	9592.8	987.2	7.2	11.0
18.5	38	9734.3	1014.6	7.2	11.0

19.0	39	9875.7	1042.0	7.2	11.0
19.5	40	10017.2	1069.4	7.2	11.0
20.0	41	10158.7	1096.8	7.2	11.0
20.5	42	10300.1	1124.3	7.2	11.0
21.0	43	10441.6	1151.7	7.2	11.0
21.5	44	10583.1	1179.1	7.2	11.0
22.0	45	10724.5	1206.5	7.2	11.0
22.5	46	10866.0	1233.9	7.2	11.0
23.0	47	11007.5	1261.4	7.2	11.0
23.5	48	11148.9	1288.8	7.2	11.0
24.0	49	11290.4	1316.2	7.2	11.0
24.5	50	11431.9	1343.6	7.2	11.0
25.0	51	11573.3	1371.1	7.2	11.0
25.5	52	11714.8	1398.5	7.2	11.0
26.0	53	11856.3	1425.9	7.2	11.0
26.5	54	11997.7	1453.3	7.2	11.0
27.0	55	12139.2	1480.7	7.2	11.0
27.5	56	12280.7	1508.2	7.2	11.0
28.0	57	12422.1	1535.6	7.2	11.0
28.5	58	12563.6	1563.0	7.2	11.0
29.0	59	12705.1	1590.4	7.2	11.0
29.5	60	12846.5	1617.8	7.2	11.0
30.0	61	12988.0	1645.3	7.2	11.0
30.5	62	13129.5	1672.7	7.2	11.0
31.0	63	13271.0	1700.1	7.2	11.0
31.5	64	13412.4	1727.5	7.2	11.0
32.0	65	13553.9	1754.9	7.2	11.0
32.5	66	13695.4	1782.4	7.2	11.0
33.0	67	13836.8	1809.8	7.2	11.0
33.5	68	13978.3	1837.2	7.2	11.0
34.0	69	14119.8	1864.6	7.2	11.0
34.5	70	14261.2	1892.1	7.2	11.0
35.0	71	14402.7	1919.5	7.2	11.0
35.5	72	14544.2	1946.9	7.2	11.0
36.0	73	14685.6	1974.3	7.2	11.0
36.5	74	14827.1	2001.7	7.2	11.0
37.0	75	14968.6	2029.2	7.2	11.0
37.5	76	15110.0	2056.6	7.2	11.0
38.0	77	15251.5	2084.0	7.2	11.0
38.5	78	15393.0	2111.4	7.2	11.0
39.0	79	15534.4	2138.8	7.2	11.0
39.5	80	15675.9	2166.3	7.2	11.0
40.0	81	15817.4	2193.7	7.2	11.0
40.5	82	15958.8	2221.1	7.2	11.0
41.0	83	16100.3	2248.5	7.2	11.0
41.5	84	16241.8	2275.9	7.2	11.0
42.0	85	16383.2	2303.4	7.2	11.0
42.5	86	16524.7	2330.8	7.2	11.0
43.0	87	16666.2	2358.2	7.2	11.0
43.5	88	16807.6	2385.6	7.2	11.0

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44.0	89	16949.1	2413.1	7.2	11.0
44.5	90	17090.6	2440.5	7.2	11.0
45.0	91	17232.0	2467.9	7.2	11.0
45.5	92	17373.5	2495.3	7.2	11.0
46.0	93	17515.0	2522.7	7.2	11.0
46.5	94	17656.4	2550.2	7.2	11.0
47.0	95	17797.9	2577.6	7.2	11.0
47.5	96	17939.4	2605.0	7.2	11.0
48.0	97	18080.8	2632.4	7.2	11.0
48.5	98	18222.3	2659.8	7.2	11.0
49.0	99	18363.8	2687.3	7.2	11.0
49.5	100	18505.2	2714.7	7.2	11.0
50.0	101	18646.7	2742.1	7.2	11.0
50.5	102	18788.2	2769.5	7.2	11.0
51.0	103	18929.6	2796.9	7.2	11.0
51.5	104	19071.1	2824.4	7.2	11.0
52.0	105	19212.6	2851.8	7.2	11.0
52.5	106	19354.0	2879.2	7.2	11.0
53.0	107	19495.5	2906.6	7.2	11.0
53.5	108	19637.0	2934.1	7.2	11.0
54.0	109	19778.4	2961.5	7.2	11.0
54.5	110	19919.9	2988.9	7.2	11.0
55.0	111	20061.4	3016.3	7.2	11.0
55.5	112	20202.8	3043.7	7.2	11.0
56.0	113	20344.3	3071.2	7.2	11.0
56.5	114	20485.8	3098.6	7.2	11.0
57.0	115	20627.2	3126.0	7.2	11.0
57.5	116	20768.7	3153.4	7.2	11.0
58.0	117	20910.2	3180.8	7.2	11.0
58.5	118	21051.6	3208.3	7.2	11.0
59.0	119	21193.1	3235.7	7.2	11.0
59.5	120	21334.6	3263.1	7.2	11.0
60.0	121	21476.0	3290.5	7.2	11.0
60.5	122	21617.5	3317.9	7.2	11.0
61.0	123	21759.0	3345.4	7.2	11.0
61.5	124	21900.4	3372.8	7.2	11.0
62.0	125	22041.9	3400.2	7.2	11.0
62.5	126	22183.4	3427.6	7.2	11.0
63.0	127	22324.8	3455.1	7.2	11.0
63.5	128	22466.3	3482.5	7.2	11.0
64.0	129	22607.8	3509.9	7.2	11.0
64.5	130	22749.2	3537.3	7.2	11.0
65.0	131	22890.7	3564.7	7.2	11.0
65.5	132	23032.2	3592.2	7.2	11.0
66.0	133	23173.6	3619.6	7.2	11.0
66.5	134	23315.1	3647.0	7.2	11.0
67.0	135	23456.6	3674.4	7.2	11.0
67.5	136	23598.0	3701.8	7.2	11.0
68.0	137	23739.5	3729.3	7.2	11.0
68.5	138	23881.0	3756.7	7.2	11.0
69.0	139	24022.4	3784.1	7.2	11.0
69.5	140	24163.9	3811.5	7.2	11.0

70.0	141	24305.4	3838.9	7.2	11.0
70.5	142	24446.8	3866.4	7.2	11.0
71.0	143	24588.3	3893.8	7.2	11.0
71.5	144	24729.8	3921.2	7.2	11.0
72.0	145	24871.2	3948.6	7.2	11.0
72.5	146	25012.7	3976.1	7.2	11.0
73.0	147	25154.2	4003.5	7.2	11.0
73.5	148	25295.6	4030.9	7.2	11.0
74.0	149	25437.1	4058.3	7.2	11.0
74.5	150	25578.6	4085.7	7.2	11.0
75.0	151	25720.0	4113.2	7.2	11.0
75.5	152	25861.5	4140.6	7.2	11.0
76.0	153	26003.0	4168.0	7.2	11.0
76.5	154	26144.4	4195.4	7.2	11.0
77.0	155	26285.9	4222.8	7.2	11.0
77.5	156	26427.4	4250.3	7.2	11.0
78.0	157	26568.8	4277.7	7.2	11.0
78.5	158	26710.3	4305.1	7.2	11.0
79.0	159	26851.8	4332.5	7.2	11.0
79.5	160	26993.2	4359.9	7.2	11.0
80.0	161	27134.7	4387.4	7.2	11.0
80.5	162	27276.2	4414.8	7.2	11.0
81.0	163	27417.6	4442.2	7.2	11.0
81.5	164	27559.1	4469.6	7.2	11.0
82.0	165	27700.6	4497.1	7.2	11.0
82.5	166	27842.0	4524.5	7.2	11.0
83.0	167	27983.5	4551.9	7.2	11.0
83.5	168	28125.0	4579.3	7.2	11.0
84.0	169	28266.4	4606.7	7.2	11.0
84.5	170	28407.9	4634.2	7.2	11.0
85.0	171	28549.4	4661.6	7.2	11.0
85.5	172	28690.8	4689.0	7.2	11.0
86.0	173	28832.3	4716.4	7.2	11.0
86.5	174	28973.8	4743.8	7.2	11.0
87.0	175	29115.2	4771.3	7.2	11.0
87.5	176	29256.7	4798.7	7.2	11.0
88.0	177	29398.2	4826.1	7.2	11.0
88.5	178	29539.6	4853.5	7.2	11.0
89.0	179	29681.1	4880.9	7.2	11.0
89.5	180	29822.6	4908.4	7.2	11.0
90.0	181	29964.0	4935.8	7.2	11.0
90.5	182	30105.5	4963.2	7.2	11.0
91.0	183	30247.0	4990.6	7.2	11.0
91.5	184	30388.5	5018.1	7.2	11.0
92.0	185	30529.9	5045.5	7.2	11.0
92.5	186	30671.4	5072.9	7.2	11.0
93.0	187	30812.9	5100.3	7.2	11.0
93.5	188	30954.3	5127.7	7.2	11.0
94.0	189	31095.8	5155.2	7.2	11.0
94.5	190	31237.3	5182.6	7.2	11.0
95.0	191	31378.7	5210.0	7.2	11.0
95.5	192	31520.2	5237.4	7.2	11.0

96.0	193	31661.7	5264.8	7.2	11.0
96.5	194	31803.1	5292.3	7.2	11.0
97.0	195	31944.6	5319.7	7.2	11.0
97.5	196	32086.1	5347.1	7.2	11.0
98.0	197	32227.5	5374.5	7.2	11.0
98.5	198	32369.0	5401.9	7.2	11.0
99.0	199	32510.5	5429.4	7.2	11.0
99.5	200	32651.9	5456.8	7.2	11.0
100.0	201	32793.4	5484.2	7.2	11.0
100.5	202	32934.9	5511.6	7.2	11.0
101.0	203	33076.3	5539.1	7.2	11.0
101.5	204	33217.8	5566.5	7.2	11.0
102.0	205	33359.3	5593.9	7.2	11.0
102.5	206	33500.7	5621.3	7.2	11.0
103.0	207	33642.2	5648.7	7.2	11.0
103.5	208	33783.7	5676.2	7.2	11.0
104.0	209	33925.1	5703.6	7.2	11.0
104.5	210	34066.6	5731.0	7.2	11.0
105.0	211	34208.1	5758.4	7.2	11.0
105.5	212	34349.5	5785.8	7.2	11.0
106.0	213	34491.0	5813.3	7.2	11.0
106.5	214	34632.5	5840.7	7.2	11.0
107.0	215	34773.9	5868.1	7.2	11.0
107.5	216	34915.4	5895.5	7.2	11.0
108.0	217	35056.9	5922.9	7.2	11.0
108.5	218	35198.3	5950.4	7.2	11.0
109.0	219	35339.8	5977.8	7.2	11.0
109.5	220	35481.3	6005.2	7.2	11.0
110.0	221	35622.7	6032.6	7.2	11.0
110.5	222	35764.2	6060.1	7.2	11.0
111.0	223	35905.7	6087.5	7.2	11.0
111.5	224	36047.1	6114.9	7.2	11.0
112.0	225	36188.6	6142.3	7.2	11.0
112.5	226	36330.1	6169.7	7.2	11.0
113.0	227	36471.5	6197.2	7.2	11.0
113.5	228	36613.0	6224.[illegible]	7.2	11.0
114.0	229	36754.5	6252.0	7.2	11.0
114.5	230	36895.9	6279.4	7.2	11.0
115.0	231	37037.4	6306.8	7.2	11.0
115.5	232	37178.9	6334.3	7.2	11.0
116.0	233	37320.3	6361.7	7.2	11.0
116.5	234	37461.8	6389.1	7.2	11.0
117.0	235	37603.3	6416.5	7.2	11.0
117.5	236	37744.7	6443.9	7.2	11.0
118.0	237	37886.2	6471.4	7.2	11.0
118.5	238	38027.7	6498.8	7.2	11.0
119.0	239	38169.1	6526.2	7.2	11.0
119.5	240	38310.6	6553.6	7.2	11.0
120.0	241	38452.1	6581.1	7.2	11.0
120.5	242	38593.5	6608.5	7.2	11.0
121.0	243	38735.0	6635.9	7.2	11.0
121.5	244	38876.5	6663.3	7.2	11.0

122.0	245	39017.9	6690.7	7.2	11.0
122.5	246	39159.4	6718.2	7.2	11.0
123.0	247	39300.9	6745.6	7.2	11.0
123.5	248	39442.3	6773.0	7.2	11.0
124.0	249	39583.8	6800.4	7.2	11.0
124.5	250	39725.3	6827.8	7.2	11.0
125.0	251	39866.7	6855.3	7.2	11.0
125.5	252	40008.2	6882.7	7.2	11.0
126.0	253	40149.7	6910.1	7.2	11.0
126.5	254	40291.1	6937.5	7.2	11.0
127.0	255	40432.6	6964.9	7.2	11.0
127.5	256	40574.1	6992.4	7.2	11.0
128.0	257	40715.5	7019.8	7.2	11.0
128.5	258	40857.0	7047.2	7.2	11.0
129.0	259	40998.5	7074.6	7.2	11.0
129.5	260	41139.9	7102.1	7.2	11.0
130.0	261	41281.4	7129.5	7.2	11.0
130.5	262	41422.9	7156.9	7.2	11.0
131.0	263	41564.3	7184.3	7.2	11.0
131.5	264	41705.8	7211.7	7.2	11.0
132.0	265	41847.3	7239.2	7.2	11.0
132.5	266	41988.7	7266.6	7.2	11.0
133.0	267	2130.2	7294.0	7.2	11.0
133.5	268	42271.7	7321.4	7.2	11.0
134.0	269	42413.1	7348.8	7.2	11.0
134.5	270	42554.6	7376.3	7.2	11.0
135.0	271	42696.1	7403.7	7.2	11.0
135.5	272	42837.5	7431.1	7.2	11.0
136.0	273	42979.0	7458.5	7.2	11.0
136.5	274	43120.5	7485.9	7.2	11.0
137.0	275	43261.9	7513.4	7.2	11.0
137.5	276	43403.4	7540.8	7.2	11.0
138.0	277	43544.9	7568.2	7.2	11.0
138.5	278	43686.3	7595.6	7.2	11.0
139.0	279	43827.8	7623.1	7.2	11.0
139.5	280	43969.3	7650.5	7.2	11.0
140.0	281	44110.7	7677.9	7.2	11.0
140.5	282	44252.2	7705.3	7.2	11.0
141.0	283	44393.7	7732.7	7.2	11.0
141.5	284	44535.1	7760.2	7.2	11.0
142.0	285	44676.6	7787.6	7.2	11.0
142.5	286	44818.1	7815.0	7.2	11.0
143.0	287	44959.5	7842.4	7.2	11.0
143.5	288	45101.0	7869.8	7.2	11.0
144.0	289	45242.5	7897.3	7.2	11.0
144.5	290	45383.9	7924.7	7.2	11.0
145.0	291	45525.4	7952.1	7.2	11.0
145.5	292	45666.9	7979.5	7.2	11.0
146.0	293	45808.3	8006.9	7.2	11.0
146.5	294	45949.8	8034.4	7.2	11.0
147.0	295	46091.3	8061.8	7.2	11.0
147.5	296	46232.7	8089.2	7.2	11.0

148.0	297	46374.2	8116.6	7.2	11.0
148.5	298	46515.7	8144.1	7.2	11.0
149.0	299	46657.1	8171.5	7.2	11.0
149.5	300	46798.6	8198.9	7.2	11.0
150.0	301	46940.1	8226.3	7.2	11.0
150.5	302	47081.5	8253.7	7.2	11.0
151.0	303	47223.0	8281.2	7.2	11.0
151.5	304	47364.5	8308.6	7.2	11.0
152.0	305	47506.0	8336.0	7.2	11.0
152.5	306	47647.4	8363.4	7.2	11.0
153.0	307	47788.9	8390.8	7.2	11.0
153.5	308	47930.4	8418.3	7.2	11.0
154.0	309	48071.8	8445.7	7.2	11.0
154.5	310	48213.3	8473.1	7.2	11.0
155.0	311	48354.8	8500.5	7.2	11.0
155.5	312	48496.2	8527.9	7.2	11.0
156.0	313	48637.7	8555.4	7.2	11.0
156.5	314	48779.2	8582.8	7.2	11.0
157.0	315	48920.6	8610.2	7.2	11.0
157.5	316	49062.1	8637.6	7.2	11.0
158.0	317	49203.6	8665.1	7.2	11.0
158.5	318	49345.0	8692.5	7.2	11.0
159.0	319	49486.5	8719.9	7.2	11.0
159.5	320	49628.0	8747.3	7.2	11.0
160.0	321	49769.4	8774.7	7.2	11.0
160.5	322	49910.9	8802.2	7.2	11.0
161.0	323	50052.4	8829.6	7.2	11.0
161.5	324	50193.8	8857.0	7.2	11.0
162.0	325	50335.3	8884.4	7.2	11.0
162.5	326	50476.8	8911.8	7.2	11.0
163.0	327	50618.2	8939.3	7.2	11.0
163.5	328	50759.7	8966.7	7.2	11.0
164.0	329	50901.2	8994.1	7.2	11.0
164.5	330	51042.6	9021.5	7.2	11.0
165.0	331	51184.1	9048.9	7.2	11.0
165.5	332	51325.6	9076.4	7.2	11.0
166.0	333	51467.0	9103.8	7.2	11.0
166.5	334	51608.5	9131.2	7.2	11.0
167.0	335	51750.0	9158.6	7.2	11.0
167.5	336	51891.4	9186.1	7.2	11.0
168.0	337	52032.9	9213.5	7.2	11.0
168.5	338	52174.4	9240.9	7.2	11.0
169.0	339	52315.8	9268.3	7.2	11.0
169.5	340	52457.3	9295.7	7.2	11.0
170.0	341	52598.8	9323.2	7.2	11.0
170.5	342	52740.2	9350.6	7.2	11.0
171.0	343	52881.7	9378.0	7.2	11.0
171.5	344	53023.2	9405.4	7.2	11.0
172.0	345	53164.6	9432.8	7.2	11.0
172.5	346	53306.1	9460.3	7.2	11.0

173.0	347	53447.6	9487.7	7.2	11.0
173.5	348	53589.0	9515.1	7.2	11.0
174.0	349	53730.5	9542.5	7.2	11.0
174.5	350	53872.0	9569.9	7.2	11.0
175.0	351	54013.4	9597.4	7.2	11.0
175.5	352	54154.9	9624.8	7.2	11.0
176.0	353	54296.4	9652.2	7.2	11.0
176.5	354	54437.8	9679.6	7.2	11.0
177.0	355	54579.3	9707.1	7.2	11.0
177.5	356	54720.8	9734.5	7.2	11.0
178.0	357	54862.2	9761.9	7.2	11.0
178.5	358	55003.7	9789.3	7.2	11.0
179.0	359	55145.2	9816.7	7.2	11.0
179.5	360	55286.6	9844.2	7.2	11.0
180.0	361	55428.1	9871.6	7.2	11.0
180.5	362	55569.6	9899.0	7.2	11.0
181.0	363	55711.0	9926.4	7.2	11.0
181.5	364	55852.5	9953.8	7.2	11.0
182.0	365	55994.0	9981.3	7.2	11.0
182.5	366	56135.4	10008.7	7.2	11.0
183.0	367	56276.9	10036.1	7.2	11.0
183.5	368	56418.4	10063.5	7.2	11.0
184.0	369	56559.8	10090.9	7.2	11.0
184 5	370	56701.3	10118.4	7.2	11.0
185.0	371	56842.8	10145.8	7.2	11.0
185.5	372	56984.2	10173.2	7.2	11.0
186.0	373	57125.7	10200.6	7.2	11.0
186.5	374	57267.2	10228.1	7.2	11.0
187.0	375	57408.6	10255.5	7.2	11.0
187.5	376	57550.1	10282 9	7.2	11.0
188.0	377	57691.6	10310.3	7.2	11.0
188.5	378	57833.0	10337.7	7.2	11.0
189.0	379	57974.5	10365.2	7.2	11.0
189.5	380	58116.0	10392.6	7.2	11.0
190.0	381	58257.4	10420.0	7.2	11.0
190.5	382	58398.9	10447.4	7.2	11.0
191.0	383	58540.4	10474.8	7.2	11.0
191.5	384	58681.8	10502.3	7.2	11.0
192.0	385	58823.3	10529.7	7.2	11.0
192.5	386	58964.8	10557.1	7.2	11.0
193.0	387	59106.2	10584.5	7.2	11.0
193.5	388	59247.7	10611.9	7.2	11.0
194.0	389	59389.2	10639.4	7.2	11.0
194.5	390	59530.6	10666.8	7.2	11.0
195.0	391	59672.1	10694.2	7.2	11.0
195.5	392	59813.6	10721.6	7.2	11.0
196.0	393	59955.0	10749.1	7.2	11.0
196.5	394	60096.5	10776.5	7.2	11.0
197.0	395	60238.0	10803.9	7.2	11.0
197.5	396	60379.4	10831.3	7.2	11.0

198.0	397	60520.9	10858.7	7.2	11.0
198.5	398	60662.4	10886.2	7.2	11.0
199.0	399	60803.8	10913.6	7.2	11.0
199.5	400	60945.3	10941.0	7.2	11.0
200.0	401	61086.8	10968.4	7.2	11.0
200.5	402	61228.2	10995.8	7.2	11.0
201.0	403	61369.7	11023.3	7.2	11.0
201.5	404	61511.2	11050.7	7.2	11.0
202.0	405	61652.6	11078.1	7.2	11.0
202.5	406	61794.1	11105.5	7.2	11.0
203.0	407	61935.6	11132.9	7.2	11.0
203.5	408	62077.0	11160.4	7.2	11.0
204.0	409	62218.5	11187.8	7.2	11.0
204.5	410	62360.0	11215.2	7.2	11.0
205.0	411	62501.4	11242.6	7.2	11.0
205.5	412	62642.9	11270.1	7.2	11.0
206.0	413	62784.4	11297.5	7.2	11.0
206.5	414	62925.8	11324.9	7.2	11.0
207.0	415	63067.3	11352.3	7.2	11.0
207.5	416	63208.8	11379.7	7.2	11.0
208.0	417	63350.2	11407.2	7.2	11.0
208.5	418	63491.7	11434.6	7.2	11.0
209.0	419	63633.2	11462.0	7.2	11.0
209.5	420	63774.6	11489.4	7.2	11.0
210.0	421	63916.1	11516.8	7.2	11.0
210.5	422	64057.6	11544.3	7.2	11.0
211.0	423	64199.0	11571.7	7.2	11.0
211.5	424	64340.5	11599.1	7.2	11.0
212.0	425	64482.0	11626.5	7.2	11.0
212.5	426	64623.5	11653.9	7.2	11.0
213.0	427	64764.9	11681.4	7.2	11.0
213.5	428	64906.4	11708.8	7.2	11.0
214.0	429	65047.9	11736.2	7.2	11.0
214.5	430	65189.3	11763.6	7.2	11.0
215.0	431	65330.8	11791.1	7.2	11.0
215.5	432	65472.3	11818.5	7.2	11.0
216.0	433	65613.7	11845.9	7.2	11.0
216.5	434	65755.2	11873.3	7.2	11.0
217.0	435	65896.7	11900.7	7.2	11.0
217.5	436	66038.1	11928.2	7.2	11.0
218.0	437	66179.6	11955.6	7.2	11.0
218.5	438	66321.1	11983.0	7.2	11.0
219.0	439	66462.5	12010.4	7.2	11.0
219.5	440	66604.0	12037.8	7.2	11.0
220.0	441	66745.5	12065.3	7.2	11.0
220.5	442	66886.9	12092.7	7.2	11.0
221.0	443	67028.4	12120.1	7.2	11.0
221.5	444	67169.9	12147.5	7.2	11.0
222.0	445	67311.3	12174.9	7.2	11.0
222.5	446	67452.8	12202.4	7.2	11.0
223.0	447	67594.3	12229.8	7.2	11.0
223.5	448	67735.7	12257.2	7.2	11.0

224.0	449	67877.2	12284.6	7.2	11.0
224.5	450	68018.7	12312.1	7.2	11.0
225.0	451	68160.1	12339.5	7.2	11.0
225.5	452	68301.6	12366.9	7.2	11.0
226.0	453	68443.1	12394.3	7.2	11.0
226.5	454	68584.5	12421.7	7.2	11.0
227.0	455	68726.0	12449.2	7.2	11.0
227.5	456	68867.5	12476.6	7.2	11.0
228.0	457	69008.9	12504.0	7.2	11.0
228.5	458	69150.4	12531.4	7.2	11.0
229.0	459	69291.9	12558.8	7.2	11.0
229.5	460	69433.3	12586.3	7.2	11.0
230.0	461	69574.8	12613.7	7.2	11.0
230.5	462	69716.3	12641.1	7.2	11.0
231.0	463	69857.7	12668.5	7.2	11.0
231.5	464	69999.2	12695.9	7.2	11.0
232.0	465	70140.7	12723.4	7.2	11.0
232.5	466	70282.1	12750.8	7.2	11.0
233.0	467	70423.6	12778.2	7.2	11.0
233.5	468	70565.1	12805.6	7.2	11.0
234.0	469	70706.5	12833.1	7.2	11.0
234.5	470	70848.0	12860.5	7.2	11.0
235.0	471	70989.5	12887.9	7.2	11.0
235.5	472	71130.9	12915.3	7.2	11.0
236.0	473	71272.4	12942.7	7.2	11.0
236.5	474	71413.9	12970.2	7.2	11.0
237.0	475	71555.3	12997.6	7.2	11.0
237.5	476	71696.8	13025.0	7.2	11.0
238.0	477	71838.3	13052.4	7.2	11.0
238.5	478	71979.7	13079.8	7.2	11.0
239.0	479	72121.2	13107.3	7.2	11.0
239.5	480	72262.7	13134.7	7.2	11.0
240.0	481	72404.1	13162.1	7.2	11.0
240.5	482	72545.6	13189.5	7.2	11.0
241.0	483	72687.1	13216.9	7.2	11.0
241.5	484	72828.5	13244.4	7.2	11.0
242.0	485	72970.0	13271.8	7.2	11.0
242.5	486	73111.5	13299.2	7.2	11.0
243.0	487	73252.9	13326.6	7.2	11.0
243.5	488	73394.4	13354.1	7.2	11.0
244.0	489	73535.9	13381.5	7.2	11.0
244.5	490	73677.3	13408.9	7.2	11.0
245.0	491	73818.8	13436.3	7.2	11.0
245.5	492	73960.3	13463.7	7.2	11.0
246.0	493	74101.7	13491.2	7.2	11.0
246.5	494	74243.2	13518.6	7.2	11.0
247.0	495	74384.7	13546.0	7.2	11.0
247.5	496	74526.1	13573.4	7.2	11.0
248.0	497	74667.6	13600.8	7.2	11.0
248.5	498	74809.1	13628.3	7.2	11.0
249.0	499	74950.5	13655.7	7.2	11.0
249.5	500	75092.0	13683.1	7.2	11.0

LEAR36/TFE731 NOISE PREDICTION AT FAR36 TAKEOFF CONDITION

NOISE SOURCE= FANI ** DISTANCE = 100.0 ** ONE-THIRD OCTAVE BAND AND OVERALL ENGINE COMPONENT SOURCE NOISE LEVEL SUMMARY

1/3 OCTAVE BAND CENTER FREQUENCY	SOUND PRESSURE LEVEL,DB MIKE LOCATIONS IN DEGREES 10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.	SOUND POWER LEVEL,DB
20.0	27.2	28.6	30.0	31.3	31.2	31.0	30.7	28.0	25.3	24.2	23.1	22.0	20.8	19.8	18.8	17.8	78.2
25.0	30.1	31.5	32.9	34.2	34.1	33.9	33.6	30.9	28.2	27.1	26.0	24.9	23.8	22.8	21.7	20.7	81.1
31.5	33.0	34.4	35.8	37.2	37.0	36.8	36.6	33.9	31.3	30.1	29.0	28.0	26.9	25.9	24.9	23.9	84.1
40.0	36.0	37.4	38.8	40.2	40.0	39.9	39.8	37.1	34.4	33.3	32.1	31.0	29.9	28.8	27.8	26.8	87.1
50.0	39.1	40.6	42.0	43.3	43.2	43.0	42.7	40.0	37.3	36.2	35.1	34.0	32.9	31.9	30.9	29.9	90.2
63.0	42.1	43.5	44.9	46.3	46.1	45.9	45.7	43.1	40.4	39.3	38.2	37.1	36.1	35.1	34.1	33.1	93.2
80.0	45.1	46.6	48.0	49.3	49.2	49.1	48.9	46.3	43.6	42.5	41.4	40.3	39.2	38.2	37.1	36.1	96.3
100.0	48.3	49.8	51.2	52.5	52.4	52.2	52.0	49.3	46.7	45.5	44.4	43.4	42.2	41.2	40.2	39.2	99.5
125.0	51.4	52.8	54.2	55.6	55.5	55.3	55.1	52.4	49.8	48.7	47.7	46.7	45.8	44.8	43.8	42.8	102.6
160.0	54.4	55.9	57.3	58.7	58.6	58.6	58.5	56.0	53.4	52.3	51.3	50.2	49.1	48.1	47.1	46.2	105.9
200.0	58.0	59.4	60.9	62.3	62.2	62.1	62.0	59.3	56.7	55.7	54.7	53.7	52.6	51.6	50.7	49.7	109.4
250.0	61.4	62.8	64.3	65.7	65.6	65.5	65.4	62.8	60.3	59.3	58.3	57.4	56.4	55.5	54.5	53.6	112.9
315.0	64.8	66.3	67.8	69.3	69.2	69.2	69.2	66.7	64.2	63.3	62.4	61.5	60.6	59.7	58.7	57.8	116.6
400.0	68.6	70.2	71.7	73.2	73.2	73.2	73.3	70.9	68.4	67.5	66.6	65.7	64.7	63.8	62.9	62.0	120.7
500.0	72.9	74.4	75.9	77.4	77.5	77.5	77.5	75.0	72.6	71.8	70.9	70.0	69.7	68.7	67.7	66.6	125.0
630.0	77.0	78.5	80.1	81.6	81.7	81.8	82.5	79.9	77.1	75.8	74.5	73.0	71.0	69.7	68.6	67.5	129.3
800.0	81.9	83.4	84.7	86.0	85.7	85.2	83.9	80.8	77.9	76.6	75.5	74.3	73.3	72.3	71.3	70.3	132.2
1000.0	83.0	84.3	85.6	86.8	86.5	86.3	86.1	83.5	80.9	79.9	78.9	78.0	77.8	76.7	75.5	74.4	133.9
1250.0	85.5	87.0	88.4	89.9	89.8	89.8	90.6	87.8	84.8	83.3	81.6	79.9	77.3	75.9	74.5	73.3	137.4
1600.0	89.9	91.2	92.5	93.6	93.0	92.3	90.3	86.9	83.6	82.0	80.5	79.2	78.2	77.0	75.9	74.8	139.3
2000.0	89.2	90.4	91.4	92.4	91.8	91.3	91.0	88.1	85.2	84.0	82.8	81.6	81.2	80.0	78.7	77.5	139.1
2500.0	90.3	91.7	92.9	94.1	93.8	93.5	94.0	91.0	87.8	86.0	84.1	82.1	79.4	77.6	76.1	74.6	141.3
3150.0	93.2	94.5	95.6	96.5	95.7	94.6	92.5	88.6	84.7	82.4	80.2	78.1	76.1	74.4	72.8	71.4	142.1
4000.0	91.4	92.4	93.1	93.5	92.2	90.8	88.7	85.0	81.5	79.5	77.3	75.1	73.3	71.4	69.8	68.3	139.2
5000.0	88.8	89.9	90.7	91.6	90.9	90.2	91.0	87.9	83.3	79.0	75.3	72.4	70.0	68.2	66.6	65.2	138.6
6300.0	96.1	97.5	97.3	96.8	94.9	91.9	85.9	81.1	76.2	73.2	70.7	68.6	66.5	64.8	63.2	61.8	142.1
8000.0	90.4	90.9	90.2	89.4	86.8	84.1	81.7	77.9	74.2	71.4	68.7	66.2	64.2	62.0	60.2	58.6	135.5
10000.0	88.9	89.7	89.7	89.7	87.9	86.0	86.1	83.1	78.6	73.5	68.3	63.9	60.1	58.2	56.5	55.1	136.8
12500.0	92.8	94.0	93.7	93.2	91.1	88.1	81.4	76.5	71.4	67.0	63.0	59.8	57.6	55.0	52.9	51.2	140.2
16000.0	88.5	89.1	88.5	87.9	85.3	82.5	81.6	78.4	73.9	68.9	63.5	58.4	53.9	50.9	48.6	46.9	136.8
20000.0	88.5	89.5	89.4	89.2	87.5	85.5	79.9	75.8	70.6	65.2	59.5	54.2	49.9	46.7	44.4	42.7	139.1

**********																	
OA(20-20K)																	
LINEAR	102.4	103.5	103.9	104.3	103.2	102.0	100.8	97.5	94.1	92.1	90.4	88.7	87.2	85.8	84.5	83.3	150.8
A-SCALE	102.1	103.3	103.9	104.5	103.5	102.5	101.5	98.2	94.8	92.9	91.1	89.5	88.0	86.6	85.2	84.0	150.7
**********																	
OA(50-10K)																	
LINEAR	101.4	102.6	103.2	103.7	102.7	101.6	100.7	97.4	94.0	92.1	90.3	88.7	87.2	85.8	84.5	83.3	149.9
A-SCALE	101.8	103.1	103.7	104.3	103.4	102.4	101.4	98.2	94.8	92.9	91.1	89.5	88.0	86.6	85.2	84.0	150.5
**********																	
PERCEIVED NOISE LEVL																	
PNL	114.6	115.8	116.3	117.1	116.2	115.1	113.9	110.7	107.3	105.4	103.4	101.5	99.5	98.0	96.7	95.5	
PNLTC	115.6	117.0	117.4	118.3	117.7	116.8	115.3	112.3	108.8	106.0	104.0	102.0	100.0	98.6	97.3	96.1	

*****STATIC LEVELS AT AMBIENT CORRECTED TO FAA STD DAY CONDITIONS (77 DEG F, 70 PCT RH) FOR FLYOVER PREDICTIONS ONLY

ORIGINAL PAGE IS OF POOR QUALITY

LEAR36/TFE731 NOISE PREDICTION AT FAR36 TAKEOFF CONDITION

NOISE SOURCE= FAN ** DISTANCE = 100.0 ** ONE-THIRD OCTAVE BAND AND OVERALL ENGINE COMPONENT SOURCE NOISE LEVEL SUMMARY

1/3 OCTAVE BAND CENTER FREQUENCY	SOUND PRESSURE LEVEL,DB MIKE LOCATIONS IN DEGREES 10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.	SOUND POWER LEVEL,DB
20.0	6.0	5.7	5.3	4.8	4.1	3.4	2.6	1.8	1.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	52.6
25.0	6.0	5.7	5.3	4.8	4.1	3.4	2.6	1.8	1.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	52.8
31.5	6.0	5.7	5.3	4.8	4.1	3.4	2.6	1.8	1.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	52.8
40.0	6.0	5.7	5.3	4.8	4.1	3.4	2.6	1.8	1.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	52.8
50.0	6.0	5.7	5.3	4.7	4.1	3.3	2.6	1.8	1.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	52.8
63.0	6.0	5.7	5.3	4.7	4.1	3.3	2.6	1.8	1.1	0.5	0.1	0.0	0.0	0.0	0.0	0.0	52.8
80.0	6.0	5.7	5.3	4.7	4.1	3.4	2.6	1.9	1.6	1.7	2.0	2.4	2.5	1.4	0.0	0.0	53.4
100.0	6.0	5.7	5.3	4.7	4.1	3.5	2.9	2.9	3.8	5.3	6.7	7.8	8.3	6.9	3.8	1.1	55.8
125.0	6.0	5.7	5.3	4.8	4.3	4.1	4.4	6.3	8.9	11.5	13.5	14.9	16.0	14.4	10.8	7.3	61.5
160.0	6.0	5.7	5.4	5.0	5.1	6.3	9.3	12.8	16.2	19.0	20.9	22.3	22.9	21.2	17.5	13.7	68.4
200.0	6.0	5.8	5.8	6.2	8.0	11.2	15.5	[illegible]	22.8	25.6	27.5	28.8	29.4	27.7	23.9	20.1	74.9
250.0	6.2	6.4	7.3	9.4	12.9	17.2	21.9	21.8	29.3	32.0	33.9	35.2	35.8	34.1	30.3	26.4	81.3
315.0	6.9	8.2	10.8	14.5	18.8	23.4	28.2	32.1	35.5	38.2	40.1	41.3	42.0	40.3	36.4	32.5	87.5
400.0	9.3	12.2	16.0	20.4	24.9	29.6	34.4	38.3	41.6	44.2	46.0	47.1	47.6	45.7	41.8	37.9	93.3
500.0	13.7	17.6	21.9	26.4	30.9	35.4	40.0	43.7	47.0	49.5	51.2	52.3	52.8	50.9	47.0	43.1	98.5
630.0	18.6	22.8	27.2	31.7	36.1	40.7	45.2	48.9	52.2	54.6	56.3	57.4	57.9	56.0	52.0	48.1	103.6
800.0	23.6	28.0	32.3	36.8	41.3	45.7	50.3	54.0	57.1	59.5	61.0	62.0	62.3	60.3	56.4	52.4	108.3
1000 0	28.6	32.9	37.3	41.7	46.1	50.4	54.8	58.3	61.3	63.6	65.1	66.0	66.3	64.3	60.3	56.3	112.4
1250.0	33.0	37.3	41.6	45.9	50.2	54.5	58.7	62.2	65.2	67.5	69.0	69.9	70.3	68.3	64.2	60.2	116.4
1600.0	36.9	41.2	45.5	49.7	54.0	58.3	62.7	66.2	69.1	71.3	72.7	73.4	73.6	71.5	67.4	63.4	120.0
2000.0	40.8	45.1	49.4	53.6	57.8	62.0	66.1	69.4	72.2	74.3	75.6	76.4	76.5	74.4	70.3	66.2	123.1
2500.0	44.1	48.3	52.5	56.7	60.8	64.9	69.0	72.2	75.0	77.0	78.3	79.0	79.1	76.9	72.8	68.7	125.8
3150.0	46.9	51.1	55.2	59.4	63.4	67.5	71.5	74.7	77.4	79.4	80.6	81.3	80.1	78.2	74.3	70.5	128.0
4000.0	49 4	53.6	57.7	61.8	65.8	69.8	71.9	75.7	79.6	83.0	85.4	87.0	90.8	88.9	85.2	81.5	135.2
5000.0	49.9	54.4	59.3	64.5	70.0	75.8	85.9	89.1	91.7	92.9	92.4	91.0	86.8	83.7	78.9	74.3	139.8
6300.0	65.5	69.6	73.3	76.9	80.2	82.9	80.5	81.5	82.4	83.3	84.0	84.6	85.1	82.9	78.7	74.6	133.7
8000.0	56.9	60.3	63.2	66.1	69.1	72.5	77.1	80.3	83.2	85.6	87.1	87.9	89.4	87.2	83.3	79.4	136.1
10000.0	54.3	58.6	62.9	67.3	71.8	76.5	83.2	86.2	88.6	89.9	89.7	89.0	86.7	83.9	79.4	75.1	138.5
12500.0	61.7	65.7	69.5	73.1	76.4	79.3	79.1	81.0	82.8	84.4	85.4	85.9	86.9	84.6	80.5	76.5	136.0
16000.0	55.0	58.7	62.2	65.8	69.5	73.5	79.3	82.2	84.7	86.1	86.3	86.0	85.1	82.5	78.2	74.0	137.5
20000.0	56.2	60.4	64.6	68.7	72.8	76.8	77.7	79.9	81.8	82.9	83.2	83.0	82.6	80.0	75.6	71.3	136.2

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OA(20-20K)																	
LINEAR	68.3	72.4	76.1	79.8	83.4	86.7	90.1	92.9	95.4	96.8	97.0	96.8	96.6	94.3	90.3	86.3	146.2
A-SCALE	67.0	71.1	74.8	78.5	82.0	85.3	89.1	92.0	94.5	95.9	96.1	95.9	96.0	93.7	89.7	85.8	144.7
++++++++++																	
OA(50-10K)																	
LINEAR	66.6	70.7	74.4	78.1	81.7	85.0	89.0	92.0	94.5	95.9	96.0	95.8	95.6	93.3	89.3	85 3	144.4
A-SCALE	66.4	70.5	74.2	77.9	81.5	84.8	88.8	91.7	94.3	95.7	95.9	95.6	95.6	93.4	89.4	85.5	144.1
++++++++++																	
PERCEIVED NOISE LEVL																	
PNL	79.0	83.1	86.9	90.7	94.2	97.5	101.5	104.6	107.2	108.6	108.7	108.2	108.6	106.5	102.6	98.8	
PNLTC	81.1	85.2	88.9	92.7	96.5	99.8	104.7	108.1	110.7	111.9	110.4	109.4	111.1	109.2	105.5	101.8	

*****STATIC LEVELS AT AMBIENT CORRECTED TO FAA STD DAY CONDITIONS (77 DEG F, 70 PCT RH) FOR FLYOVER PREDICTIONS ONLY

ORIGINAL PAGE IS
OF POOR QUALITY

LEAR36/TFE731 NOISE PREDICTION AT FAR36 TAKEOFF CONDITION

NOISE SOURCE= COMB ** DISTANCE = 100.0 ** ONE-THIRD OCTAVE BAND AND OVERALL ENGINE COMPONENT SOURCE NOISE LEVEL SUMMARY

1/3 OCTAVE BAND CENTER FREQUENCY	SOUND PRESSURE LEVEL,DB MIKE LOCATIONS IN DEGREES 10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.	SOUND POWER LEVEL,DB
20.0	35.6	37.4	39.0	40.7	42.6	43.9	45.1	46.4	48.3	49.9	51.0	51.7	51.9	52.0	51.9	51.9	99.6
25.0	39.7	41.4	43.0	44.7	46.6	47.9	49.1	50.4	52.3	54.0	55.1	55.8	56.0	56.1	56.1	56.1	103.6
31.5	43.7	45.4	47.0	48.7	50.7	52.0	53.2	54.5	56.5	58.2	59.3	60.1	60.3	60.5	60.4	60.5	107.9
40.0	47.8	49.5	51.2	52.9	54.9	56.2	57.5	58.9	60.8	62.5	63.6	64.4	64.6	64.8	64.6	64.6	112.2
50.0	52.2	53.9	55.5	57.3	59.2	60.5	61.8	63.1	64.9	66.5	67.5	68.1	68.1	68.2	68.0	68.0	116.0
63.0	56.4	58.1	59.7	61.3	63.2	64.4	65.4	66.6	68.3	69.9	70.8	71.5	71.6	71.7	71.5	71.5	119.4
80.0	59.9	61.6	63.1	64.7	66.6	67.7	68.8	70.0	71.8	73.3	74.3	74.9	75.0	75.1	74.9	74.8	122.8
100.0	63.3	65.0	66.6	68.2	70.0	71.1	72.3	73.4	75.1	76.5	77.3	77.8	77.7	77.6	77.4	77.3	125.8
125.0	66.7	68.4	69.9	71.4	73.1	74.1	74.9	75.9	77.6	79.0	79.8	80.3	80.3	80.3	80.1	80.0	128.4
160.0	69.3	70.9	72.4	73.9	75.6	76.6	77.6	78.6	80.2	81.6	82.4	82.9	83.0	82.9	82.6	82.5	131.0
200.0	72.0	73.6	75.1	76.6	78.2	79.2	80.3	81.2	82.7	84.0	84.6	84.9	84.6	84.4	84.1	83.9	133.1
250.0	74.6	76.2	77.6	79.0	80.5	81.3	81.9	82.7	84.1	85.2	85.8	86.0	86.0	85.7	85.3	85.1	134.5
315.0	76.1	77.7	79.0	80.3	81.8	82.5	83.3	84.0	85.2	86.1	86.4	86.5	85.9	85.5	85.0	84.7	[illegible]
400.0	77.4	78.9	80.2	81.3	82.6	83.1	83.3	83.7	84.7	85.4	85.6	85.4	84.8	84.3	83.7	83.3	134.5
500.0	77.2	78.7	79.8	80.8	81.9	82.2	82.2	82.4	83.3	83.9	84.0	83.8	83.3	82.8	82.1	81.8	133.2
630.0	76.0	77.4	78.4	79.3	80.4	80.6	80.8	80.9	81.7	82.2	82.2	81.9	81.1	80.5	79.8	79.4	131.5
800.0	74.5	75.8	76.8	77.7	78.6	78.7	78.6	78.6	79.2	79.6	79.5	79.2	78.4	77.8	77.0	76.6	129.2
1000.0	72.2	73.5	74.4	75.2	76.0	76.1	75.9	75.9	76.4	76.8	76.7	76.4	75.7	75.0	74.3	73.9	126.5
1250.0	69.5	70.8	71.7	72.4	73.2	73.2	73.2	73.1	73.7	74.0	73.7	73.2	72.2	71.4	70.6	70.1	123.6
1600.0	66.7	68.0	68.9	69.6	70.3	70.2	69.7	69.5	69.8	70.0	69.7	69.2	68.2	67.5	66.7	66.2	120.1
2000.0	63.1	64.3	65.1	65.7	66.3	66.2	65.8	65.5	65.9	66.2	65.9	65.4	64.7	64.0	63.2	62.7	116.3
2500.0	59.1	60.3	61.1	61.8	62.4	62.3	62.2	62.0	62.4	62.7	62.5	62.0	61.2	60.5	59.7	59.2	112.8
3150.0	55.5	56.8	57.6	58.3	59.0	58.9	58.7	58.5	58.9	59.1	58.8	58.3	57.3	56.5	55.6	55.1	109.3
4000.0	52.0	53.3	54.1	54.7	55.3	55.2	54.7	54.4	54.7	54.9	54.6	54.0	53.1	52.3	51.5	51.0	105.5
5000.0	48.0	49.2	50.0	50.6	51.2	51.0	50.6	50.3	50.6	50.8	50.4	49.8	48.9	48.1	47.2	46.7	101.4
6300.0	43.8	45.0	45.7	46.3	46.9	46.7	46.3	45.9	46.2	46.3	45.8	45.2	44.0	43.1	42.2	41.7	97.2
8000.0	39.3	40.5	41.2	41.7	42.2	41.9	41.3	40.8	41.0	41.0	40.5	39.8	38.8	37.9	37.0	36.4	92.6
10000.0	34.0	35.2	35.9	36.3	36.8	36.4	35.9	35.4	35.6	35.6	35.1	34.5	33.5	32.6	31.7	31.1	87.8
12500.0	28.3	29.5	30.2	30.6	31.1	30.7	30.3	29.8	29.9	29.9	29.3	28.5	27.1	26.1	25.1	24.5	82.8
16000.0	22.2	23.3	24.0	24.4	24.8	24.3	23.4	22.8	22.8	22.6	22.0	21.2	20.1	19.2	18.2	17.6	77.4
20000.0	15.3	16.4	16.9	17.3	17.6	17.0	16.5	15.9	15.9	15.8	15.2	14.4	13.3	12.3	11.4	10.8	71.8

++++++++++																	
OA(20-20K)																	
LINEAR	84.9	86.4	87.6	88.7	90.0	90.5	91.0	91.5	92.6	93.5	93.9	93.9	93.6	93.2	92.8	92.5	142.7
A-SCALE	81.6	83.0	84.1	85.0	36.1	86.4	86.6	86.8	87.7	88.3	88.4	88.3	87.7	87.2	86.6	86.3	137.7
++++++++++																	
OA(50-10K)																	
LINEAR	84.9	86.4	87.6	88.7	90.0	90.5	91.0	91.5	92.6	93.5	93.8	93.9	93.6	93.2	92.7	92.5	142.7
A-SCALE	81.6	83.0	84.1	85.0	86.1	86.4	86.6	86.8	87.7	88.3	88.4	88.3	87.7	87.2	86.6	86.3	137.7
++++++++++																	
PERCEIVED NOISE LEVL																	
PNL	91.1	92.5	93.7	94.8	95.9	96.4	96.6	96.9	97.9	98.6	98.8	98.7	98.1	97.7	97.1	96.8	
PNLTC	91.2	92.6	93.8	94.9	96.1	96.5	96.7	97.0	98.0	98.8	98.9	98.8	98.2	97.8	97.2	96.9	

*****STATIC LEVELS AT AMBIENT CORRECTED TO FAA STD DAY CONDITIONS (77 DEG F, 70 PCT RH) FOR FLYOVER PREDICTIONS ONLY

LEAR36/TFE731 NOISE PREDICTION AT FAR36 TAKEOFF CONDITION

NOISE SOURCE= JET ** DISTANCE = 100.0 ** ONE-THIRD OCTAVE BAND AND OVERALL ENGINE COMPONENT SOURCE NOISE LEVEL SUMMARY

1/3 OCTAVE BAND CENTER FREQUENCY	SOUND PRESSURE LEVEL,DB MIKE LOCATIONS IN DEGREES 10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.	SOUND POWER LEVEL,DB
20.0	61.1	61.3	61.5	61.8	62.3	63.0	63.8	64.8	65.9	67.4	69.1	71.6	75.4	78.8	81.8	85.1	125.5
25.0	63.5	63.6	63.8	64.2	64.6	65.3	66.1	67.1	68.2	69.7	71.3	74.1	78.4	82.2	85.1	87.6	128.4
31.5	65.8	65.9	66.1	66.5	67.0	67.6	68.4	69.4	70.6	72.0	73.7	76.6	81.5	85.6	88.3	90.1	131.2
40.0	68.3	68.4	68.6	69.0	69.4	70.1	70.9	71.9	73.0	74.5	76.1	79.2	84.7	89.2	91.3	92.5	134.1
50.0	70.4	70.5	70.8	71.1	71.6	72.2	73.0	74.0	75.2	76.6	78.3	81.3	87.2	92.2	93.5	94.2	136.3
63.0	72.6	72.7	73.0	73.3	73.8	74.5	75.3	76.2	77.4	78.9	80.5	83.9	90.6	94.7	95.1	95.6	138.4
80.0	75.0	75.1	75.3	75.7	76.2	76.8	77.6	78.6	79.8	81.2	82.9	86.4	93.0	96.5	96.8	96.8	140.1
100.0	76.9	77.1	77.3	77.7	78.2	78.8	79.6	80.6	81.8	83.2	84.9	88.4	94.3	97.8	98.2	97.6	141.4
125.0	78.5	78.6	78.9	79.3	79.8	80.5	81.3	82.3	83.5	84.9	86.6	90.0	95.5	98.8	99.4	98.0	142.4
160.0	79.8	80.0	80.2	80.6	81.2	81.8	82.7	83.7	84.9	86.3	88.1	91.8	96.9	99.6	100.0	97.5	143.2
200.0	80.8	80.9	81.2	81.6	82.2	82.8	83.7	84.7	85.9	87.3	89.3	93.1	97.6	100.0	99.8	96.4	143.5
250.0	81.6	81.8	82.1	82.5	83.1	83.7	84.6	85.6	86.8	88.2	90.3	94.1	97.5	99.5	98.8	94.6	143.2
315.0	82.4	82.5	82.8	83.3	83.8	84.5	85.3	86.4	87.6	89.0	91.1	94.6	97.2	98.5	97.0	92.6	142.7
400.0	82.9	83.1	83.4	83.8	84.4	85.1	85.9	86.9	88.1	89.5	91.7	94.7	96.5	97.1	95.1	90.6	142.1
500.0	83.2	83.4	83.7	84.1	84.7	85.4	86.3	87.3	88.5	89.9	91.8	94.2	95.2	95.5	93.3	88.6	141.3
630.0	83.4	83.6	83.9	84.3	84.9	85.6	86.5	87.5	88.7	90.1	91.9	93.5	93.9	93.8	91.4	86.6	140.6
800.0	83.3	83.5	83.8	84.3	84.9	85.6	86.5	87.5	88.7	90.1	91.7	92.7	92.4	92.1	89.5	84.6	139.9
1000.0	83.2	83.4	83.7	84.2	84.8	85.5	86.4	87.4	88.6	90.0	91.4	91.8	91.0	90.4	87.7	82.6	139.3
1250.0	82.8	83.0	83.4	83.8	84.4	85.2	86.1	87.1	88.3	89.7	90.9	90.8	89.7	88.8	86.0	80.7	138.6
1600.0	82.2	82.4	82.8	83.2	83.8	84.6	85.5	86.5	87.7	89.1	90.2	89.7	88.2	87.0	84.0	78.6	137.8
2000.0	81.5	81.7	82.1	82.6	83.2	83.9	84.8	85.9	87.1	88.4	89.4	88.6	86.8	85.4	82.2	76.7	137.0
2500.0	80.8	81.1	81.4	81.9	82.5	83.2	84.1	85.2	86.4	87.8	88.6	87.5	85.4	83.7	80.4	74.7	136.2
3150.0	80.0	80.2	80.5	81.0	81.6	82.4	83.3	84.3	85.6	86.9	87.7	86.3	84.0	82.1	78.6	72.7	135.3
4000.0	78.9	79.2	79.5	80.0	80.6	81.4	82.3	83.3	84.6	85.9	86.6	85.1	82.5	80.3	76.6	70.7	134.4
5000.0	77.9	78.1	78.5	78.9	79.6	80.3	81.2	82.3	83.5	84.9	85.6	83.9	81.2	78.7	74.9	68.7	133.4
6300.0	76.8	77.0	77.4	77.8	78.5	79.2	80.1	81.2	82.4	83.8	84.4	82.6	79.8	77.0	73.0	66.7	132.5
8000.0	75.6	75.9	76.2	76.7	77.3	78.1	79.0	80.0	81.3	82.6	83.3	81.4	78.3	75.2	71.1	64.7	131.7
10000.0	74.4	74.7	75.1	75.5	76.2	76.9	77.8	78.9	80.1	81.5	82.1	80.2	76.9	73.6	69.3	62.7	131.0
12500.0	73.3	73.5	73.9	74.4	75.0	75.8	76.7	77.7	79.0	80.3	80.9	79.0	75.5	72.0	67.5	60.8	130.7
16000.0	72.1	72.3	72.7	73.2	73.8	74.6	75.5	76.5	77.8	79.1	79.7	77.7	74.0	70.2	65.6	58.7	130.8
20000.0	70.9	71.2	71.5	72.0	72.7	73.4	74.3	75.4	76.6	78.0	78.6	76.5	72.7	68.6	63.8	56.7	131.0

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OA(20-20K)																	
LINEAR	94.5	94.7	95.0	95.4	96.0	96.7	97.6	98.6	99.8	101.2	102.7	104.5	106.9	108.8	108.4	106.5	153.8
A-SCALE	92.9	93.1	93.4	93.9	94.5	95.2	96.1	97.2	98.4	99.7	101.0	101.4	101.5	101.6	99.7	95.5	149.5
++++++++++																	
OA(50-10K)																	
LINEAR	94.4	94.6	94.9	95.3	95.9	96.6	97.5	98.5	99.7	101.1	102.6	104.4	106.8	108.7	108.3	106.1	153.6
A-SCALE	92.9	93.1	93.4	93.9	94.5	95.2	96.1	97.1	98.3	99.7	101.0	101.4	101.5	101.6	99.7	95.5	149.5
++++++++++																	
PERCEIVED NOISE LEVL																	
PNL	105.8	106.0	106.3	106.8	107.4	108.1	109.0	110.0	111.3	112.6	113.8	113.8	114.0	114.5	113.0	109.3	
PNLTC	105.8	106.0	106.3	106.8	107.4	108.1	109.0	110.1	111.3	112.7	113.8	113.9	114.0	114.5	113.0	109.3	

*****STATIC LEVELS AT AMBIENT CORRECTED TO FAA STD DAY CONDITIONS (77 DEG F, 70 PCT RH) FOR FLYOVER PREDICTIONS ONLY

LEAR36/TFE731 NOISE PREDICTION AT FAR36 TAKEOFF CONDITION

NOISE SOURCE= ATUR ** DISTANCE = 100.0 ** ONE-THIRD OCTAVE BAND AND OVERALL ENGINE COMPONENT SOURCE NOISE LEVEL SUMMARY

1/3 OCTAVE BAND CENTER FREQUENCY	SOUND PRESSURE LEVEL,DB MIKE LOCATIONS IN DEGREES 10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.	SOUND POWER LEVEL,DB
20.0	45.3	46.1	46.8	47.4	47.9	48.3	48.7	49.1	49.5	53.4	55.4	54.3	50.5	45.7	41.4	39.2	101.2
25.0	46.3	47.1	47.8	48.3	48.8	49.3	49.7	50.1	50.5	54.4	56.4	55.3	51.5	46.7	42.4	40.2	102.1
31.5	47.3	48.1	48.7	49.3	49.8	50.3	50.7	51.1	51.5	55.4	57.4	56.3	52.6	47.7	43.5	41.3	103.1
40.0	48.3	49.1	49.7	50.3	50.8	51.3	51.7	52.1	52.5	56.5	58.4	57.4	53.6	48.7	44.4	42.3	104.2
50.0	49.3	50.1	50.8	51.4	51.9	52.3	52.7	53.1	53.5	57.4	59.4	58.3	54.5	49.7	45.4	43.2	105.2
63.0	50.3	51.1	51.8	52.3	52.8	53.3	53.7	54.1	54.5	58.4	60.4	59.4	55.6	50.7	46.5	44.3	106.2
80.0	51.3	52.1	52.8	53.3	53.9	54.3	54.7	55.1	55.5	59.5	61.4	60.4	56.6	51.7	47.5	45.3	107.2
100.0	52.3	53.1	53.8	54.4	54.9	55.3	55.7	56.1	56.5	60.5	62.4	61.4	57.5	52.7	48.4	46.2	108.2
125.0	53.3	54.1	54.8	55.4	55.9	56.3	56.7	57.1	57.5	61.4	63.4	62.4	58.6	53.8	49.5	47.3	109.2
160.0	[illegible]	55.1	55.7	56.3	56.8	57.3	57.8	58.2	58.6	[illegible]	64.5	63.4	59.6	54.8	50.5	48.3	110.3
200.0	55.3	56.1	56.8	57.4	57.9	58.4	58.8	59.2	59.6	63.5	65.4	64.4	60.6	55.7	51.5	49.3	111.2
250.0	56.3	57.1	57.8	58.4	58.9	59.3	59.7	60.1	60.5	64.5	66.4	65.4	61.6	56.8	52.5	50.3	112.2
315.0	57.3	58.1	58.8	59.4	59.9	60.3	60.7	61.1	61.6	65.5	67.5	66.4	62.6	57.8	53.6	51.4	113.3
400.0	58.3	59.1	59.8	60.4	60.9	61.4	61.8	62.2	62.6	66.6	68.5	67.5	63.7	58.8	54.6	52.4	114.3
500.0	59.4	60.2	60.8	61.4	61.9	62.4	62.8	63.2	63.6	67.6	69.5	68.5	64.7	59.8	55.6	53.4	115.4
630.0	60.4	61.2	61.8	62.4	62.9	63.4	63.8	64.2	64.6	68.6	70.6	69.5	65.8	61.0	56.7	54.5	116.4
800.0	61.4	62.2	62.9	63.5	64.0	64.4	64.9	65.3	65.7	69.6	71.5	70.4	66.4	61.5	57.2	55.0	117.4
1000.0	62.5	63.3	63.9	64.5	65.0	65.3	65.5	65.9	66.2	70.1	72.1	71.0	67.2	62.4	58.1	56.0	118.1
1250.0	63.0	63.8	64.5	65.0	65.5	65.9	66.4	66.8	67.2	71.1	73.1	72.1	68.3	63.5	59.2	57.1	119.1
1600.0	63.9	64.7	65.4	66.0	66.5	66.9	67.4	67.8	68.3	72.2	74.2	73.1	69.3	64.5	60.2	58.0	120.2
2000.0	64.9	65.7	66.4	67.0	67.5	68.0	68.4	68.8	69.2	73.2	75.2	74.1	70.3	65.5	61.3	59.1	121.3
2500.0	65.9	66.7	67.4	68.0	68.5	69.0	69.3	69.8	70.3	74.3	[illegible]	75.4	71.7	66.9	62.7	60.6	122.5
3150.0	66.8	67.7	68.4	69.0	[illegible]	[illegible]	70.6	71.2	71.8	[illegible]	[illegible]	77.3	73.7	69.0	64.9	62.8	124.3
4000.0	68.2	69.0	69.8	70.5	71.2	[illegible]	72.6	73.3	74.0	78.2	80.4	79.6	76.1	71.5	67.3	65.2	126.7
5000.0	70.3	71.2	72.0	72.8	73.6	74.3	[illegible]	75.8	76.5	80.7	82.9	82.0	78.3	73.6	69.4	67.3	129.2
6300.0	72.7	73.6	74.4	75.2	75.9	76.6	77.1	77.8	78.4	82.5	84.7	83.8	80.3	75.5	71.4	69.2	131.4
8000.0	74.5	75.4	76.2	76.9	77.6	78.3	79.0	79.6	80.2	84.3	86.4	85.5	81.7	76.9	72.7	70.6	133.4
10000.0	76.2	77.0	77.8	78.5	79.2	79.8	80.2	80.8	81.4	[illegible]	87.7	86.8	83.1	78.4	74.3	72.2	135.3
12500.0	77.1	77.9	78.7	79.4	80.1	80.7	81.3	82.0	82.7	86.9	89.1	88.3	84.9	80.2	76.1	74.0	[illegible]
16000.0	77.7	78.6	79.4	80.2	81.0	81.7	82.6	83.3	84.0	88.2	[illegible]	89.6	85.8	81.1	76.9	74.8	140.1
20000.0	79.0	79.9	80.8	81.6	82.4	83.2	83.6	84.3	85.0	89.2	91.5	90.6	86.7	81.9	77.7	75.5	142.5

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OA(20-20K)																	
LINEAR	85.0	85.9	86.7	87.5	68.2	88.9	89.5	90.1	90.8	95.0	97.2	96.3	92.6	87.9	83.7	81.5	146.3
A-SCALE	81.8	82.6	83.4	84.2	84.8	35.5	86.1	86.7	87.3	91.5	93.6	92.8	89.1	84.4	80.2	78.1	141.5
++++++++++																	
OA(50-10K)																	
LINEAR	81.1	82.0	82.8	83.5	84.1	84.8	85.3	85.9	86.5	90.6	92.8	91.9	88.2	83.5	79.3	77.2	139.7
A-SCALE	80.4	81.2	82.0	82.7	83.4	84.0	84.6	85.2	85.0	89.9	92.0	91.1	87.5	82.7	78.6	76.4	138.8
++++++++++																	
PERCEIVED NOISE LEVEL																	
PNL	9[illegible].0	93.8	94.6	95.3	96.0	96.6	97.1	97.7	98.3	102.4	104.5	103.6	100.0	95.2	91.0	88.9	
PNLTC	93.0	93.9	94.7	95.4	96.0	96.6	97.2	97.8	98.4	102.5	104.6	103.7	100.0	95.3	91.1	88.9	

*****STATIC LEVELS AT AMBIENT CORRECTED TO FAA STD DAY CONDITIONS (77 DEG F, 70 PCT RH) FOR FLYOVER PREDICTIONS ONLY

LEAR36/TFE731 NOISE PREDICTION AT FAR36 TAKEOFF CONDITION

NOISE SOURCE= TC [illegible] ** DISTANCE = 100.0 ** ONE-THIRD OCTAVE BAND AND OVERALL ENGINE COMPONENT SOURCE NOISE LEVEL SUMMARY

1/3 OCTAVE BAND CENTER FREQUENCY	SOUND PRESSURE LEVEL,DB — MIKE LOCATIONS IN DEGREES 10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.	SOUND POWER LEVEL,DB
[illegible].0	61.3	61.4	61.7	62.0	62.5	63.2	64.0	64.9	66.1	67.6	69.3	71.8	75.4	78.8	81.8	[illegible].1	125.6
25.0	62.6	63.7	64.0	64.3	64.8	65.5	66.3	67.2	68.4	69.9	71.6	74.2	78.5	82.2	85.1	87.6	128.4
31.5	65.9	66.0	66.3	66.6	67.2	67.8	68.6	69.6	70.8	72.3	73.9	76.7	81.5	85.6	88.3	90.1	131.2
40.0	68.3	68.5	68.7	69.1	69.7	70.3	71.1	72.1	73.3	74.8	76.4	79.3	84.7	89.3	91.3	92.5	134.1
50.0	70.5	70.7	70.9	71.3	71.9	72.6	73.4	74.4	75.6	77.1	78.7	81.5	87.3	92.2	93.5	94.2	136.4
63.0	72.7	72.9	73.2	73.6	74.2	74.9	75.7	76.7	78.0	79.4	81.0	84.2	90.6	94.7	95.2	95.6	138.4
80.0	75.1	75.3	75.6	76.1	76.7	77.4	78.2	79.2	80.4	81.9	83.5	86.7	93.0	96.5	96.8	96.8	140.2
100.0	77.1	77.3	[illegible]	78.2	78.8	79.5	80.4	81.4	82.7	84.1	85.6	88.7	94.4	97.8	98.3	97.6	141.5
125.0	78.8	79.1	79.4	80.0	80.7	81.4	82.2	83.2	84.5	85.9	87.4	90.5	95.6	98.8	99.4	98.0	142.6
160.0	80.2	80.5	80.9	81.5	82.3	83.0	83.9	84.9	86.2	87.6	89.1	92.4	97.1	99.7	100.1	97.6	143.5
200.0	81.3	81.7	82.2	82.9	83.7	84.5	85.3	86.3	87.6	89.0	90.6	93.7	97.8	100.1	99.9	96.6	143.9
250.0	82.5	82.9	83.5	84.2	85.0	85.8	86.5	87.4	88.[illegible]	90.0	91.6	94.7	97.8	99.6	98.9	95.1	143.7
315.0	[illegible]	83.9	84.4	85.2	86.0	86.7	87.5	88.4	89.[illegible]	90.8	92.4	95.2	97.5	98.7	97.3	93.3	143.4
400.0	84.1	84.7	85.3	86.0	86.8	87.4	88.0	88.7	89.8	91.0	92.6	95.2	96.8	97.3	95.4	91.3	142.8
500.0	84.5	85.0	85.7	86.4	87.0	87.6	88.1	88.7	89.7	90.9	92.5	94.6	95.5	95.7	93.6	89.5	142.1
630.0	84.9	85.5	86.2	87.0	87.5	88.0	88.7	89.0	89.8	90.9	92.4	93.8	94.1	94.0	91.8	87.4	141.4
800.0	86.0	86.8	87.7	88.6	88.7	88.9	88.8	88.8	89.5	90.7	92.1	93.0	92.6	92.3	89.8	85.4	140.9
1000.0	86.3	87.1	88.0	88.9	89.0	89.1	89.5	89.1	89.5	90.6	91.8	92.2	91.4	90.7	88.2	83.7	140.6
1250.0	87.5	88.5	89.7	90.9	91.0	91.1	92.0	90.6	90.1	90.7	91.6	91.3	90.1	89.1	86.4	81.8	141.2
1600.0	90.6	91.8	93.0	94.0	93.6	93.0	91.6	89.8	89.3	90.0	90.8	90.3	88.8	87.6	84.8	80.4	141.7
2000.0	89.9	91.0	91.9	92.8	92.4	92.0	92.0	90.2	89.4	90.0	90.6	89.7	88.2	86.8	84.1	80.4	141.3
2500.0	90.8	92.1	93.2	94.4	94.2	93.9	94.5	92.1	90.3	90.3	90.4	89.2	87.3	85.4	82.4	78.3	142.6
3150.0	93.4	94.7	95.7	96.6	95.9	94.9	93.0	90.1	88.6	89.0	89.4	88.3	86.2	84.2	80.8	76.6	143.1
4000.0	91.7	92.7	93.3	93.7	92.6	91.4	89.8	87.7	87.3	88.7	89.9	89.8	91.6	89.6	85.9	82.1	141.7
5000.0	89.2	90.3	91.0	91.9	91.3	90.9	92.6	92.1	92.9	93.9	93.6	92.3	88.4	85.3	80.8	76.4	142.9
6300.0	96.2	97.6	97.3	97.0	95.2	92.7	88.2	86.6	86.6	88.1	89.2	88.6	87.3	84.5	80.4	76.4	143.4
8000.0	90.7	91.2	90.5	89.9	87.7	86.1	85.5	85.6	86.7	89.2	90.7	90.4	90.4	87.9	83.9	80.1	140.5
10000.0	89.2	90.1	90.1	90.2	88.8	87.7	89.0	89.1	90.2	91.7	92.3	91.4	88.6	85.3	80.9	77.1	142.2
12500.0	93.0	94.1	93.9	93.5	91.6	89.5	86.1	85.9	86.7	89.4	91.1	90.6	89.2	86.2	82.0	78.5	143.3
16000.0	88.9	89.6	89.1	88.7	87.0	85.8	86.5	86.9	88.0	90.6	92.1	91.3	88.6	85.0	80.7	77.4	143.4
20000.0	89.0	90.0	90.0	[illegible]	88.9	88.0	86.1	86.4	87.2	90.4	92.3	91.4	88.3	84.2	79.9	77.0	145.0

++++++++++																	
OA(20-20K)																	
LINEAR	103.1	104.2	104.6	105.0	104.3	103.6	103.2	102.4	102.7	104.0	105.1	106.0	107.6	109.1	108.6	106.7	156.7
A-SCALE	102.7	103.8	104.4	104.9	104.2	103.4	103.0	101.6	101.4	102.4	103.2	103.3	103.0	102.6	100.5	96.7	154.1
++++++++++																	
OA(50-10K)																	
LINFAR	102.3	103.4	103.9	104.5	103.8	103.2	102.9	102.0	102.3	103.4	104.4	105.6	107.4	108.9	108.5	106.4	155.8
A-SCALE	102.4	103.5	104.2	104.8	104.0	103.3	102.9	101.5	101.3	102.2	103.0	103.1	102.9	102.5	100.5	96.4	153.8
++++++++++																	
PERCEIVED NOISE LEVL																	
PNL	116.2	117.3	117.7	118.5	117.9	117.2	116.5	115.1	115.4	116.5	117.0	116.9	117.4	116.7	114.4	111.1	
PNLTC	117.2	118.4	118.8	119.7	119.3	118.5	117.7	116.7	117.4	118.[illegible]	117.9	117.6	118.8	118.3	116.1	113.0	

LEAR36/TFE731 NOISE PREDICTION AT FAR36 TAKEOFF CONDITION

DETAILED FLYOVER NOISE LEVELS,BY COMPONENT, AT EACH 1/2 SECOND INTERVAL ALONG THE PROFILE

TIME SEC	RANGE FEET	ALTITUDE FEET	SLANT DIST,FT	ENGINE-OBSERVER ANGLE,DEG	ELEV ANGLE DEG	COMPONENT	PNL DB	PNLTC DB	OVERALL DB	A-WEIGHTED DB(A)
0.0	4500.0	0.0	16730.0	18.2	-0.0	FANI	28.5	28.8	20.2	19.2
						FAND	24.2	24.2	13.0	14.0
						COMB	33.6	33.6	29.7	23.0
						JET	38.7	38.7	36.9	28.9
						ATUR	24.7	24.7	14.6	14.0
						TOTL	41.0	41.0	37.8	30.3
0.5	4641.5	27.4	16588.5	18.2	0.1	FANI	28.3	28.7	20.1	19.0
						FAND	24.2	24.2	13.0	14.0
						COMB	33.8	33.8	30.1	23.2
						JET	38.8	38.9	37.1	29.0
						ATUR	24.7	24.7	14.7	14.0
						TOTL	41.2	41.2	38.0	30.4
1.0	4782.9	54.8	16447.1	18.3	0.2	FANI	28.4	28.8	20.5	19.1
						FAND	24.2	24.2	13.0	14.0
						COMB	34.6	34.6	[illegible]	24.[illegible]
						JET	39.7	39.8	[illegible]1	30.0
						ATUR	24.9	24.9	[illegible].4	14.0
						TOTL	42.0	42.0	39.0	31.3
1.5	4924.4	82.3	16305.8	18.4	0.3	FANI	28.8	29.1	21.1	19.5
						FAND	24.2	24.2	13.0	14.0
						COMB	35.6	35.6	32.4	25.4
						JET	40.8	40.8	39.4	31.1
						ATUR	25.1	25.1	16.2	14.0
						TOTL	43.0	43.0	40.2	32.4
2.0	5065.9	109.7	16164.5	18.5	0.4	FANI	29.1	29.5	21.8	19.9
						FAND	24.2	24.2	13.0	14.0
						COMB	36.5	36.5	33.5	26.4
						JET	41.7	41.8	40.5	32.1
						ATUR	25.4	25.4	17.0	14.0
						TOTL	43.9	43.9	41.3	33.4
2.5	5207.3	137.1	16023.2	18.6	0.5	FANI	29.6	29.9	22.5	20.5
						FAND	24.2	24.2	13.0	14.0
						COMB	37.3	37.3	34.5	27.3
						JET	42.6	42.6	41.4	33.0
						ATUR	25.7	25.7	17.7	14.1
						TOTL	44.7	44.7	42.2	34.3

ORIGINAL PAGE IS OF POOR QUALITY

3.0	5348.8	164.5	15882.0	18.7	0.6	FANI	30.0	30.3	23.1	21.0
						FAND	24.2	24.2	13.0	14.0
						COMB	38.0	38.0	35.5	28.1
						JET	43.3	43.4	42.2	33.8
						ATUR	25.9	25.9	18.4	14.2
						TOTL	45.3	45.3	43.0	35.1
76.5	26144.4	4[illegible]95.4	6459.1	157.7	40.5	FANI	25.4	26.0	15.8	15.6
						FAND	32.4	32.6	22.7	22.9
						COMB	60.2	60.4	59.1	51.2
						JET	73.2	73.5	71.5	61.8
						ATUR	33.3	33.5	27.5	23.5
						TOTL	73.6	73.8	71.8	62.1
77.0	26295.9	4222.8	6584.9	158.3	39.8	FANI	25.3	25.9	15.5	15.4
						FAND	31.6	31.9	22.0	22.2
						COMB	60.0	60.2	58.8	51.0
						JET	72.7	73.0	71.0	61.3
						ATUR	32.8	33.1	27.1	23.1
						TOTL	73.1	73.3	71.3	61.7
77.5	26427.4	4250.3	6711.4	158.9	39.2	FANI	25.2	25.8	15.3	15.2
						FAND	31.0	31.3	21.4	21.6
						COMB	59.8	60.1	58.6	50.8
						JET	72.2	72.5	70.6	60.8
						ATUR	32.4	32.6	26.7	22.6
						TOTL	72.6	72.9	70.8	61.2

LEAR36/TFE731 NOISE PREDICTION AT FAR36 TAKEOFF CONDITION

AIRCRAFT NOISE LEVEL PREDICTIONS AT MINIMUM SLANT DISTANCE

TIME SEC	RANGE FEET	ALTITUDE FEET	SLANT DIST,FT	ENGINE-OBSERVER ANGLE,DEG	ELEV ANGLE DEG	COMPONENT	PNL DB	PNLTC DB	OVERALL DB	A-WEIGHTED DB(A)
57.0	20627.2	3126.0	3179.7	97.2	79.1	FANI	44.5	45.2	36.5	35.8
						FAND	58.5	62.6	45.6	46.4
						COMB	70.0	70.2	67.0	61.0
						JET	77.7	78.2	72.1	68.1
						ATUR	58.3	58.6	49.6	47.5
						TOTL	79.0	81.7	73.3	68.9

LEAR36/TFE731 NOISE PREDICTION AT FAR36 TAKEOFF CONDITION

SUMMARY OUTPUT OF PREDICTED NOISE LEVELS

COMPONENT	EPNL DB	MAX PNLTC DB	TIME AT MAX PNLTC	ANGLE,DEG MAX PNLTC	DUR CORR	DUR TIME	MAX PNL	TIME AT MAX PNL	ANGLE,DEG MAX PNL	MAX OVERALL DB	TIME AT MAX OVERALL	MAX A-WEIGHTED DB	TIME AT MAX A-WEIGHTED
FANI	56.6	54.1	46.5	53.6	2.4	31.5	53.4	46.5	53.6	45.9	43.5	45.1	44.0
FAND	61.5	62.9	57.5	99.8	-1.4	15.5	58.9	58.0	102.4	46.6	59.5	47.4	59.5
COMB	72.4	70.6	58.5	105.0	1.8	33.0	70.4	58.5	105.0	67.5	59.5	61.2	58.5
JET	83.8	82.5	64.5	131.4	1.3	27.5	81.9	64.5	131.4	79.1	67.0	71.2	64.0
ATUR	59.3	61.3	59.5	110.0	-2.0	15.0	60.7	59.5	110.0	52.4	59.5	50.2	59.5
TOTL	85.2	83.0	64.5	131.4	2.1	28.5	82.3	64.0	129.6	79.3	67.0	71.4	64.0

FAR36 STAGE 3 NOISE LIMIT FOR INPUT AIRCRAFT IS 89.0 EPN(DB)

*****FLYOVER AIRCRAFT NOISE PREDICTION CASE COMPLETED*****

*****PSEUDOTONES BELOW 1000 HZ WERE ELIMINATED PER FAA FAR36, B36.5.M , (IPSEUD=1).
*****FLYOVER NOISE LEVELS INCLUDE A DOPPLER SHIFT.

```
                                                    NASA LEWIS RESEARCH CENTER                                 PAGE  13
                                                   NASA GASP NOISE MODULE OUTPUT
*****************************************************************************************************************************
                         LEAR36/TFE731 NOISE PREDICTION AT FAR36 TAKEOFF CONDITION
*****************************************************************************************************************************
++++++++++INPUT VARIABLE STATUS AT JOB END+++++
++++++++++INPUT VARIABLE STATUS AT JOB END+++++
                                       INPUT DATA - USER INPUT AND DEFAULT VALUES USED
*****************************************************************************************************************************
CONTROL VARIABLES  *
********************

IFAA= 2   TAKEOFF ,     IPOUT= 3   FULL     ,                ISTAG= 3            ICAB= 0             ISI= 0  (ENGL UNITS)

************************
ENVIRONMENTAL VARIABLES*
************************

TAMB=536.7          PAMB= 2116.2        RH= 70.             DIST= 100.0         NLOC= 16

ANGLE (ARRAY) =  10.0  20.0  30.0  40.0  50.0  60.0  70.0  80.0  90.0 100.0 110.0 120.0 130.0 140.0 150.0 160.0


************************
ENGINE/AIRCRAFT SYSTEM *
************************

+++++ENGINE VARIABLES+++++
ENGINE TYPE(NTYE)= 1  (FAN )  ........................ENGINE COMPONENT ARRAY(ICOMP) =     1    4    5    6    0    0
                                                                                        FAN  COMB JET  ATUR NONE NONE

+++++AIRFRAME VARIABLES+++++
AMACH=0.25          VEL= 288.2          ENP= 2.             ANENGI=  0.0        ANENGF=  0.0        XL=  5.5
YL=  2.6            ZL= 16.7            WGMAX= 17000.       LOCENG= 1           IPHASE= 0           IDOP= 1

****************
FLIGHT PROFILE *
****************

IDPRO= 0                                VEL= 288.2          AMACH=0.25          FLTANG=11.0         ANGAFT= 7.2
TOROLL= 4500.       APDIST=    0.0      XALT=1000.

*****A STRAIGHT LINE PROFILE WILL BE COMPUTED FROM A COMBINATION OF THE ABOVE VARIABLES.

****************
FLIGHT OPTIONS *
****************

KGOLD=  0           XLSIDE=     0.0     XRSIDE=     0.0     IQS=  1             ICUT=  0            IPSEUD=  1
IDUR= 1             XTOL= 100.          IWING= 0
XFAA= 7516.,21230.,21325.,    0.,       YFAA=     4.,     4.,     4.,     4.,   ZFAA=     0.,     0., 1476.,     0.,

*****THE FLIGHT PROFILE WILL BE TERMINATED WHEN THE OVERALL ENGINE PNLTC IS 10 DB BELOW ITS MAXIMUM VALUE (IDUR=1).
```

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****************************************************************************************************************************************
                          LEAR36/,FE731 NOISE PPEDICTION AT FAR36 TAKEOFF CONDITION
****************************************************************************************************************************************
++++++++++INPUT VAPIAB!  STATUS AT JOB END+++++
++++++++++INPUT VARIABLE STATUS AT JOB END+++++
*********  ****. .******************
ENGINE COMPONENT VARIABLES AT INPUT*
************************************

+++++FAN +++++
IGV= 0              IFD= 0              NH= 8               NSTG= 1             NBF= 30             NVAN=109
RSS=200.00          WAFAN=104.82        RPM= 11161.         DELT= 80.70         FPR= 0.0            FANDIA= 2.3190
FANHUB= 1.1250      .IPMC=1.4800        TIPM=1.2862         FANEFF=0.0          NBF2=  0            NVAN2=  0
FAND2= 0.0          TIPMO2=0.0          TIPM2=0.0           RSS2=100.00         PRAT= 0.0           TRAT=0.0
'ANEF2=0.0          IBUZ= 0             ITONE= 0            AMACH=0.2537        CAEF= 40.0

+++++CO .B+++++
WACOMB=  28.85      T3=1269.0           T4=2287.4           P3= 27995.0         CAEC= 20.0
AMACH=0.254

+++++JET +++++
VJ=1509.0           TJ=1427.0           DJ= 0.9594          HJ=0.47970          GAMJ=1.3330         VJ2= 922.0
TJ2= 613.0          DJ2= 1.6292         HJ2=0.33490         GAMJ2=1.4010        EL2=  0.78          ALFAJ= 7.20
PHIJ= 0 0           V0= 288.2           INVOPT= 0

+++  'TUR+++++
RPMT. 20076.0       DT= 1.266           DH= 0.745           ACNZ= 0.824         NBT= 80             DTOT=0.45000
PRTS= 0.0           GAMAT=1.33300       CAET= 40.0          AMACH=0.254

***** A DOPPLER FREQUENCY SHIFT WILL BE APPLIED TO ALL SOURCE STATIC SPECTRA AS A FUNCTION OF FLIGHT MACH NO. AND ANGLE FROM INLET.
```

APPENDIX A

Sample Test Case 3

Sideline Condition for a Turbofan-Powered Executive Aircraft

PRECEDING PAGE BLANK NOT FILMED

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************************************************************************************************************************
                         LEAR36/TFE731 NOISE PREDICTION AT FAR36 SIDELINE CONDITION
************************************************************************************************************************
                                     INPUT DATA - USER INPUT AND DEFAULT VALUES USED
************************************************************************************************************************
CONTROL VARIABLES  *
*******************

IFAA= 3   SIDELINE,     IPOUT= 3   FULL    ,               ISTAG= 3            ICAB= 0             ISI= 0  (ENGL UNITS)

************************
ENVIRONMENTAL VARIABLES*
************************

TAMB=536.7          PAMB= 2116.2        RH= 70.             DIST= 100.0         NLOC= 16

ANGLE (ARRAY) =  10.0  20.0  30.0  40.0  50.0  60.0  70.0  80.0  90.0 100.0 110.0 120.0 130.0 140.0 150.0 160.0


************************
ENGINE/AIRCRAFT SYSTEM *
************************

+++++ENGINE VARIABLES+++++
ENGINE TYPE(NTYE)= 1  (FAN )  ........................ENGINE COMPONENT ARRAY(ICOMP) =     1    4    5    6    0    0
                                                                                        FAN  COMB JET  ATUR NONE NONE

+++++AIRFRAME VARIABLES+++++
AMACH=0.25          VEL= 281.9          ENP= 2.             ANENGI=  0.0        ANENGE=  0.0        XL=  5.5
YL=  2.6            ZL= 16.7            WGMAX= 17000.       LOCENG= 1           IPHASE= 0           IDOP= 1

****************
FLIGHT PROFILE *
****************

IDPRO= 0                                VEL= 281.9          AMACH=0.25          FLTANG=11.0         ANGAFT= 7.2
TOROLL= 4500.       APDIST=    0.0      XALT=1000.

*****A STRAIGHT LINE PROFILE WILL BE COMPUTED FROM A COMBINATION OF THE ABOVE VARIABLES.

****************
FLIGHT OPTIONS *
****************

KGOLD=  1           XLSIDE=     0.0     XRSIDE=     0.0     IQS=  1             ICUT=  0            IPSEUD=  1
IDUR= 1             XTOL= 100.          IWING= 0
XFAA= 7516.,21230.,21230.,    0.,       YFAA=    4.,    4.,    4.,    4.,       ZFAA=    0.,    0., 1520.,    0.,

*****THE FLIGHT PROFILE WILL BE TERMINATED WHEN THE OVERALL ENGINE PNLTC IS 10 DB BELOW ITS MAXIMUM VALUE (IDUR=1).
```

```
                                  NASA GASP NOISE MODULE OUTPUT
****************************************************************************************************************************
                    LEAR36/TFE731 NOISE PREDICTION AT FAR36 SIDELINE CONDITION
****************************************************************************************************************************
**********************************
ENGINE COMPONENT VARIABLES AT INPUT*
**********************************

+++++FAN +++++
IGV= 0              IFD= 0              NH= 8               NSTG= 1             NBF= 30             NVAN=109
RSS=200.00          WAFAN=108.50        RPM= 11091.         DELT= 79.40         FPR= 0.0            FANDIA= 2.3190
FANHUB= 1.1250      TIPMD=1.4800        TIPM=0.0            FANEFF=0.0          NBF2=  0            NVAN2=  0
FAND2= 0.0          TIPMD2=0.0          TIPM?=0.0           RSS2=100.00         PRAT= 0.0           TRAT=0.0
FANEF2=0.0          IBUZ= 0             ITONE= 0            AMACH=0.2482        CAEF= 40.0

+++++COMB+++++
WACOMB=  29.50      T3=1268.5           T4=2280.5           P3= 28653.0         CAEC= 20.0
AMACH=0.248

+++++JET +++++
VJ=1473.0           TJ=1425.0           DJ= 0.9594          HJ=0.50000          GAMJ=1.3330         VJ2= 915.0
TJ2= 620.0          DJ2= 1.6292         HJ2=0.33490         GAMJ2=1.4010        EL2=  0.78          ALFAJ= 7.20
PHIJ=56.31          V0= 281.9           INVOPT= 0

+++++ATUR+++++
RPMT= 19951.0       DT= 1.282           DH= 0.816           ACNZ= 0.824         NBT= 80             DTOT=0.45000
PRTS= 0.0           GAMAT=1.33300       CAET= 40.0          AMACH=0.248

***** A DOPPLER FREQUENCY SHIFT WILL BE APPLIED TO ALL SOURCE STATIC SPECTRA AS A FUNCTION OF FLIGHT MACH NO. AND ANGLE FROM INLET.
```

LEAR36/TFE731 NOISE PREDICTION AT FAR36 SIDELINE CONDITION

FLIGHT PROFILE GENERATED FOR FLYOVER PREDICTIONS

VEL= 281.9 AMACH=0.248 TOROLL= 4500. APDIST= 0. XALT=1000. (FOR LEVEL FLYOVER)

TIME SECONDS	IPRO	RANGE FEET	ALTITUDE FEET	AIRCRAFT ANGLE OF ATTACK,DEG	FLIGHT ANGLE DEG
0.0	1	4500.0	0.0	7.2	11.0
0.5	2	4638.4	26.8	7.2	11.0
1.0	3	4776.7	53.6	7.2	11.0
1.5	4	4915.1	80.5	7.2	11.0
2.0	5	5053.5	107.3	7.2	11.0
2.5	6	5191.9	134.1	7.2	11.0
3.0	7	5330.2	160.9	7.2	11.0
3.5	8	5468.6	187.8	7.2	11.0
4.0	9	5607.0	214.6	7.2	11.0
4.5	10	5745.4	241.4	7.2	11.0
5.0	11	5883.7	268.2	7.2	11.0
5.5	12	6022.1	295.0	7.2	11.0
6.0	13	6160.5	321.9	7.2	11.0
6.5	14	6298.9	348.7	7.2	11.0
7.0	15	6437.2	375.5	7.2	11.0
7.5	16	6575.6	402.3	7.2	11.0
8.0	17	6714.0	429.1	7.2	11.0
8.5	18	6852.4	456.0	7.2	11.0
9.0	19	6990.7	482.8	7.2	11.0
9.5	20	7129.1	509.6	7.2	11.0
10.0	21	7267.5	536.4	7.2	11.0
10.5	22	7405.9	563.3	7.2	11.0
11.0	23	7544.2	590.1	7.2	11.0
11.5	24	7682.6	616.9	7.2	11.0
12.0	25	7821.0	643.7	7.2	11.0
12.5	26	7959.4	670.5	7.2	11.0
13.0	27	8097.7	697.4	7.2	11.0
13.5	28	8236.1	724.2	7.2	11.0
14.0	29	8374.5	751.0	7.2	11.0
14.5	30	8512.9	777.8	7.2	11.0
15.0	31	8651.2	804.6	7.2	11.0
15.5	32	8789.6	831.5	7.2	11.0
16.0	33	8928.0	858.3	7.2	11.0
16.5	34	9066.4	885.1	7.2	11.0
17.0	35	9204.7	911.9	7.2	11.0
17.5	36	9343.1	938.8	7.2	11.0
18.0	37	9481.5	965.6	7.2	11.0
18.5	38	9619.9	992.4	7.2	11.0

19.0	39	9758.2	1019.2	7.2	11.0
19.5	40	9896.6	1046.0	7.2	11.0
20 0	41	10035.0	1072.9	7.2	11.0
20.5	42	10173.4	1099.7	7.2	11.0
21.0	43	10311.7	1126.5	7.2	11.0
21.5	44	10450.1	1153.3	7.2	11.0
22.0	45	10588.5	1180.2	7.2	11.0
22.5	46	10726.9	1207.0	7.2	11.0
23.0	47	10865.2	1233.8	7.2	11.0
23.5	48	11003.6	1260.6	7.2	11.0
24.0	49	11142.0	1287.4	7.2	11.0
24.5	50	11280.4	1314.3	7.2	11.0
25.0	51	11418.7	1341.1	7.2	11.0
25.5	52	11557.1	1367.9	7.2	11.0
26.0	53	11695.5	1394.7	7.2	11.0
26.5	54	11833.8	1421.5	7.2	11.0
27.0	55	11972.2	1448.4	7.2	11.0
27.5	56	12110.6	1475.2	7.2	11.0
28.0	57	12249.0	1502.0	7.2	11.0
28.5	58	12387.3	1528.8	7.2	11.0
29.0	59	12525.7	1555.7	7.2	11.0
29.5	60	12664.1	1582.5	7.2	11.0
30.0	61	128[illegible]2.5	1609.3	7.2	11.0
30.5	62	12940.8	1636.1	7.2	11.0
31.0	63	13079.2	1662.9	7.2	11.0
31.5	64	13217.6	1669.8	7.2	11.0
32.0	65	13356.0	1716.6	7.2	11.0
32.5	66	13494.3	1743.4	7.2	11.0
33.0	67	13632.7	1770.2	7.2	11.0
33.5	68	13771.1	1797.0	7.2	11.0
34.0	69	13909.5	1823.9	7.2	11.0
34.5	70	14047.8	1850.7	7.2	11.0
35.0	71	14186.2	1877.5	7.2	11.0
35.5	72	14324.6	1904.3	7.2	11.0
36.0	73	14463.0	1931.2	7.2	11.0
36.5	74	14601.3	1958.0	7.2	11.0
37.0	75	14739.7	1984.8	7.2	11.0
37 5	76	14878.1	2011.6	7.2	11.0
38.0	77	15016.5	2038.4	7.2	11.0
38.5	78	15154.8	2065.3	7.2	11.0
39.0	79	15293.2	2092.1	7.2	11.0
39.5	80	15431.6	2118.9	7.2	11.0
40.0	81	15570.0	2145.7	7.2	11.0
40.5	82	15708.3	2172.6	7.2	11.0
41.0	83	15846.7	2199.4	7.2	11.0
41.5	84	15985.1	2226.2	7.2	11.0
42.0	85	16123.5	2253.0	7.2	11.0
42.5	86	16261.8	2279.8	7.2	11.0
43.0	87	16400.2	2306.7	7.2	11.0
43.5	88	16538.6	2333.5	7.2	11.0

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44.0	89	16677.0	2360.3	7.2	11.0
44.5	90	16815.3	2387.1	7.2	11.0
45.0	91	16953.7	2413.9	7.2	11.0
45.5	92	17092.1	2440.8	7.2	11.0
46.0	93	17230.5	2467.6	7.2	11.0
46.5	94	17368.8	2494.4	7.2	11.0
47.0	95	17507.2	2521.2	7.2	11.0
47.5	96	17645.6	2548.1	7.2	11.0
48.0	97	17784.0	2574.9	7.2	11.0
48.5	98	17922.3	2641.7	7.2	11.0
49.0	99	18060.7	2628.5	7.2	11.0
49.5	100	18199.1	2655.3	7.2	11.0
50.0	201	18337.5	2682.2	7.2	11.0
50 5	102	18475.8	2709.0	7.2	11.0
51.0	103	18614.2	2735.8	7.2	11.0
51.5	104	18752.6	2762.6	7.2	11.0
52.0	105	18890.9	2769.5	7.2	11.0
52.5	106	19029.3	2816.3	7.2	11.0
53.0	107	19167.7	2843.1	7.2	11.0
53.5	108	19306.1	2869.9	7.2	11.0
54.0	109	19444.4	2896.7	7.2	11.0
54.5	110	19582.8	2923.6	7.2	11.0
55.0	111	19721.2	2950.4	7.2	11.0
55.5	112	19859.6	2977.2	7.2	11.0
56.0	113	19997.9	3004.0	7.2	11.0
56.5	114	20136.3	3030.8	7.2	11.0
57.0	115	20274.7	3057.7	7.2	11.0
57.5	116	20413.1	3084.5	7.2	11.0
58.0	117	20551.4	3111.3	7.2	11.0
58.5	118	20689.8	3138.1	7.2	11.0
59.0	119	20828.2	3165.0	7.2	11.0
59.5	120	20966.6	3191.8	7.2	11.0
60.0	121	21104.9	3218.6	7.2	11.0
60.5	122	21243.3	3245.4	7.2	11.0
61.0	123	21381.7	3272.2	7.2	11.0
61.5	124	21520.1	3299.1	7.2	11.0
62.0	125	21658.4	3325.9	7.2	11.0
62.5	126	21796.8	3352.7	7.2	11.0
63.0	127	21935.2	3379.5	7.2	11.0
63.5	128	22073.6	3406.3	7.2	11.0
64.0	129	22211.9	3433.2	7.2	11.0
64.5	130	22350.3	3460.0	7.2	11.0
65.0	131	22488.7	3486.8	7.2	11.0
65.5	132	22627.1	3513.6	7.2	11.0
66.0	133	22765.4	3540.5	7.2	11.0
66.5	134	22903.8	3567.3	7.2	11.0
67.0	135	23042.2	3594.1	7.2	11.0
67.5	136	23180.6	3620.9	7.2	11.0
68.0	137	23318.9	3647.7	7.2	11.0
68.5	138	23457.3	3674.6	7.2	11.0
69.0	139	23595.7	3701.4	7.2	11.0
69.5	140	23734.1	3728.2	7.2	11.0

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70.0	141	23872.4	3755.0	7.2	11.0
70.5	142	24010.8	3781.9	7.2	11.0
71.0	143	24149.2	3808.7	7.2	11.0
71.5	14[illegible]	[illegible]87.6	3835.5	7.2	11.0
72.0	145	24425.9	3862.3	7.2	11.0
72.5	146	24564.3	3889.1	7.2	11.0
73.0	147	24702.7	3916.0	7.2	11.0
73.5	148	24841.1	3942.8	7.2	11.0
74.0	149	24979.4	3969.6	7.2	11.0
74.5	150	25117.8	3996.4	7.2	11.0
75.0	151	2[illegible]256.2	4023.2	7.2	11.0
75.5	152	25394.5	4050.1	7.2	11.0
76.0	153	25532.9	4076.9	7.2	11.0
76.5	154	25671.3	4103.7	7.2	11.0
77.0	155	25809.7	4130.5	7.2	11.0
77.5	156	25948.0	4157.4	7.2	11.0
78.0	157	26086.4	4184.2	7.2	11.0
78.5	158	26224.8	4211.0	7.2	11.0
79.0	159	26363.2	4237.8	7.2	11.0
79.5	160	26501.5	4264.6	7.2	11.0
80.0	161	26639.9	4291.5	7.2	11.0
80.5	162	26778.3	4318.3	7.2	11.0
81.0	163	26916.7	4345.1	7.2	11.0
81.5	164	27055.0	4371.9	7.2	11.0
82.0	165	27193.4	4398.7	7.2	11.0
82.5	166	27331.8	4425.6	7.2	11.0
83.0	167	27470.2	4452.4	7.2	11.0
[illegible].5	168	27608.5	4479.2	7.2	11.0
84.0	169	27746.9	4506.0	7.2	11.0
84.5	170	27885.3	453[illegible].9	7.2	11.0
85.0	171	28023.7	45[illegible].7	7.2	11.0
85.5	172	28162.0	458[illegible].5	7.2	11.0
86.0	173	28300.4	461[illegible].3	7.2	11.0
86.5	174	28438.8	464[illegible].1	7.2	11.0
87.0	175	28577.2	4667.0	7.2	11.0
87.5	176	28715.5	4693.[illegible]	7.2	11.0
88.0	177	28853.9	4720.6	7.2	11.0
88.5	178	28992.3	4747.4	7.2	11.0
89.0	179	29130.7	4774.3	7.2	11.0
89.5	180	29269.0	4801.1	7.2	11.0
90.0	181	29407.4	4827.9	7.2	11.0
90.5	182	29545.8	4854.7	7.2	11.0
91.0	183	29684.2	4881.5	7.2	11.0
91.5	184	29822.5	4908.4	7.2	11.0
92.0	185	29960.9	4935.2	7.2	11.0
92.5	186	30099.3	4962.0	7.2	11.0
93.0	187	30237.7	4988.8	7.2	11.0
93.5	188	30376.0	5015.6	7.2	11.0
94.0	189	30514.4	5042.5	7.2	11.0
94.5	190	30652.8	5069.3	7.2	11.0
95.0	191	30791.2	5096.1	7.2	11.0
95.5	192	30929.5	5122.9	7.2	11.0

96.0	193	31067.9	5149.8	7.2	11.0
96.5	194	31206.3	5176.6	7.2	11.0
97.0	195	31344.7	5203.4	7.2	11.0
97.5	196	31483.0	5230.2	7.2	11.0
98.0	197	31621.4	[illegible]	7.2	11.0
98.5	198	31759.8	5283.9	7.2	11.0
99.0	199	31898.2	5310.7	7.2	11.0
99.5	200	32036.5	5337.5	7.2	11.0
100.0	201	32174.9	5364.3	7.2	11.0
100.5	202	32313.3	5391.1	7.2	11.0
101.0	203	32451.6	5418.0	7.2	11.0
101.5	204	32590.0	5444.8	7.2	11.0
102.0	205	32728.4	5471.6	7.2	11.0
102.5	206	32866.8	5498.4	7.2	11.0
103.0	207	33005.1	5525.3	7.2	11.0
103.5	208	33143.5	5552.1	7.2	11.0
104.0	209	33281.9	5578.9	7.2	11.0
104.5	210	33420.3	5605.7	7.2	11.0
105.0	211	33558.6	5632.5	7.2	11.0
105.5	212	33697.0	5659.4	7.2	11.0
106.0	213	33835.4	5686.2	7.2	11.0
106.5	214	33973.8	5713.0	7.2	11.0
107.0	215	34112.1	5739.8	7.2	11.0
107.5	216	34250.5	5766.7	7.2	11.0
108.0	217	34388.9	5793.5	7.2	11.0
108.5	218	34527.3	5820.3	7.2	11.0
109.0	219	34665.6	5847.1	7.2	11.0
109.5	220	34804.0	5873.9	7.2	11.0
110.0	221	34942.4	5900.8	7.2	11.0
110.5	222	35080.8	5927.6	7.2	11.0
111.0	223	35219.1	5954.4	7.2	11.0
111.5	224	35357.5	5981.2	7.2	11.0
112.0	225	35495.9	6008.0	7.2	11.0
112.5	226	35634.3	6034.9	7.2	11.0
113.0	227	35772.6	6061.7	7.2	11.0
113.5	228	35911.0	6088.5	7.2	11.0
114.0	[illegible]	[illegible]	6115.3	7.2	11.0
114.5	230	36187.8	6142.2	7.2	11.0
115.0	231	36326.1	6169.0	7.2	11.0
115.5	232	36464.5	6195.8	7.2	11.0
116.0	233	36602.9	6222.6	7.2	11.0
116.5	234	36741.3	6249.4	7.2	11.0
117.0	235	36879.6	6276.3	7.2	11.0
117.5	236	37018.0	6303.1	7.2	11.0
118.0	237	37156.4	6329.9	7.2	11.0
118.5	238	37294.8	6356.7	7.2	11.0
119.0	239	37433.1	6383.5	7.2	11.0
119.5	240	37571.5	6410.4	7.2	11.0
120.0	241	37709.9	6437.2	7.2	11.0
120.5	242	37848.3	6464.0	7.2	11.0
121.0	243	37986.6	6490.8	7.2	11.0
121.5	244	38125.0	6517.7	7.2	11.0

122.0	245	38263.4	6544.5	7.2	11.0
122.5	246	38401.8	6571.3	7.2	11.0
123.0	247	38540.1	6598.1	7.2	11.0
123.5	248	38678.5	6624.9	7.2	11.0
124.0	249	38816.9	6651.8	7.2	11.0
124.5	250	38955.3	6678.6	7.2	11.0
125.0	251	39093.6	6705.4	7.2	11.0
125.5	252	39232.0	6732.2	7.2	11.0
126.0	253	39376.4	6759.1	7.2	11.0
126.5	254	39508.7	6785.9	7.2	11.0
127.0	255	39647.1	6812.7	7.2	11.0
127.5	256	39785.5	6839.5	7.2	11.0
128.0	257	39923.9	6866.3	7.2	11.0
128.5	258	40062.2	6893.2	7.2	11.0
129.0	259	40200.6	6920.0	7.2	11.0
129.5	260	40339.0	6946.8	7.2	11.0
130.0	261	40477.4	6973.6	7.2	11.0
130.5	262	40615.7	7000.4	7.2	11.0
131.0	263	40754.1	7027.3	7.2	11.0
131.5	264	40892.5	7054.1	7.2	11.0
132.0	265	41030.9	7080.9	7.2	11.0
132.5	266	41169.2	7107.7	7.2	11.0
133.0	267	41307.6	7134.6	7.2	11.0
133.5	268	41446.0	7161.4	7.2	11.0
134.0	269	41584.4	7188.2	7.2	11.0
134.5	270	41722.7	7215.0	7.2	11.0
135.0	271	41861.1	7241.8	7.2	11.0
135.5	272	41999.5	7268.7	7.2	11.0
136.0	273	42137.9	7295.5	7.2	11.0
136.5	274	42276.2	7322.3	7.2	11.0
137.0	275	42414.6	7349.1	7.2	11.0
137.5	276	42553.0	7375.9	7.2	11.0
138.0	277	42691.4	7402.8	7.2	11.0
138.5	278	42829.7	7429.6	7.2	11.0
139.0	279	42968.1	7456.4	7.2	11.0
139.5	280	43106.5	7483.2	7.2	11.0
140.0	281	43244.9	7510.1	7.2	11.0
140.5	282	43383.2	7536.9	7.2	11.0
141.0	283	43521.6	7563.7	7.2	11.0
141.5	284	43660.0	7590.5	7.2	11.0
142.0	285	43798.4	7617.3	7.2	11.0
142.5	286	43936.7	7644.2	7.2	11.0
143.0	287	44075.1	7671.0	7.2	11.0
143.5	288	44213.5	7697.8	7.2	11.0
144.0	289	44351.9	7724.6	7.2	11.0
144.5	290	44490.2	7751.5	7.2	11.0
145.0	291	44628.6	7778.3	7.2	11.0
145.5	292	44767.0	7805.1	7.2	11.0
146.0	293	44905.4	7831.9	7.2	11.0
146.5	294	45043.7	7858.7	7.2	11.0
147.0	295	45182.1	7885.6	7.2	11.0
147.5	296	45320.5	7912.4	7.2	11.0

148.0	297	45458.9	7939.2	7.2	11.0
148.5	298	45597.2	7966.0	7.2	11.0
149.0	299	45735.6	7992.8	7.2	11.0
149.5	300	45874.0	8019.7	7.2	11.0
150.0	301	46012.4	8046.5	7.2	11.0
150.5	302	46150.7	8073.3	7.2	11.0
151.0	303	46289.1	8100.1	7.2	11.0
151.5	304	46427.5	8127.0	7.2	11.0
152.0	305	46565.8	8153.8	7.2	11.0
152.5	306	46704.2	8180.6	7.2	11.0
153.0	307	46842.6	8207.4	7.2	11.0
153.5	308	46981.0	8234.2	7.2	11.0
154.0	309	47119.3	8261.1	7.2	11.0
154.5	310	47257.7	8287.9	7.2	11.0
155.0	311	47396.1	8314.7	7.2	11.0
155.5	312	47534.5	8341.5	7.2	11.0
156.0	313	47672.8	8368.4	7.2	11.0
156.5	314	47811.2	8395.2	7.2	11.0
157.0	315	47949.6	8422.0	7.2	11.0
157.5	316	48088.0	8448.8	7.2	11.0
158.0	317	48226.3	8475.6	7.2	11.0
158.5	318	48364.7	8502.5	7.2	11.0
159.0	319	48503.1	8529.3	7.2	11.0
159.5	320	48641.5	8556.1	7.2	11.0
160.0	321	48779.8	8582.9	7.2	11.0
160.5	322	48918.2	8609.7	7.2	11.0
161.0	323	49056.6	8636.6	7.2	11.0
161.5	324	49195.0	8663.4	7.2	11.0
162.0	325	49333.3	8690.2	7.2	11.0
162.5	326	49471.7	8717.0	7.2	11.0
163.0	327	49610.1	8743.9	7.2	11.0
163.5	328	49748.5	8770.7	7.2	11.0
164.0	329	49886.8	8797.5	7.2	11.0
164.5	330	50025.2	8824.3	7.2	11.0
165.0	331	50163.6	8851.1	7.2	11.0
165.5	332	50302.0	8878.0	7.2	11.0
166.0	333	50440.3	8904.8	7.2	11.0
166.5	334	50578.7	8931.6	7.2	11.0
167.0	335	50717.1	8958.4	7.2	11.0
167.5	336	50855.5	8985.2	7.2	11.0
168.0	337	50993.8	9012.1	7.2	11.0
168.5	338	51132.2	9038.9	7.2	11.0
169.0	339	51270.6	9065.7	7.2	11.0
169.5	340	51409.0	9092.5	7.2	11.0
170.0	341	51547.3	9119.4	7.2	11.0
170.5	342	51685.7	9146.2	7.2	11.0
171.0	343	51824.1	9173.0	7.2	11.0
171.5	344	51962.5	9199.8	7.2	11.0
172.0	345	52100.8	9226.6	7.2	11.0
172.5	346	52239.2	9253.5	7.2	11.0

173.0	347	52377.6	92[illegible].3	7.2	11.0
173.5	348	52516.0	93[illegible]1	7.2	11.0
174.0	349	52654.3	9333.9	7.2	11.0
174.5	350	52792.7	9360.8	7.2	11.0
175.0	351	52931.1	9387.6	7.2	11.0
175.5	352	53069.4	9414.4	7.2	11.0
176.0	353	53207.8	9441.2	7.2	11.0
176.5	354	53346.2	9468.0	7.2	11.0
177.0	355	53484.6	9494.9	7.2	11.0
177.5	356	53622.9	9521.7	7.2	11.0
178.0	357	53761.3	9548.5	7.2	11.0
178.5	358	53899.7	9575.3	7.2	11.0
179.0	359	54038.1	9602.1	7.2	11.0
179.5	360	54176.4	9629.0	7.2	11.0
180.0	361	54314.8	9655.8	7.2	11.0
180.5	362	54453.2	9682.6	7.2	11.0
181.0	363	54591.6	9709.4	7.2	11.0
181.5	364	54729.9	9736.3	7.2	11.0
182.0	365	54868.3	9763.1	7.2	11.0
182.5	366	55006.7	9789.9	7.2	11.0
183.0	367	55145.1	9816.7	7.2	11.0
183.5	368	55283.4	9843.5	7.2	11.0
184.0	369	55421.8	9870.4	7.2	11.0
184.5	370	55560.2	9897.2	7.2	11.0
185.0	371	55698.6	9924.0	7.2	11.0
185.5	372	55836.9	9950.8	7.2	11.0
186.0	373	55975.3	9977.6	7.2	11.0
186.5	374	56113.7	10004.5	7.2	11.0
187.0	375	56252.1	10031.3	7.2	11.0
187.5	376	56390.4	10058.1	7.2	11.0
188.0	377	56528.8	10084.9	7.2	11.0
188.5	378	56667.2	10111.8	7.2	11.0
189.0	379	56805.6	10138.6	7.2	11.0
189.5	380	56943.9	10165.4	7.2	11.0
190.0	381	57082.3	10192.2	7.2	11.0
190.5	382	57220.7	10219.0	7.2	11.0
191.0	383	57359.1	10245.9	7.2	11.0
191.5	384	57497.4	10272.7	7.2	11.0
192.0	385	57635.8	10299.5	7.2	11.0
192.5	386	57774.2	10326.3	7.2	11.0
193.0	387	57912.6	10353.2	7.2	11.0
193.5	388	58050.9	10380.0	7.2	11.0
194.0	389	58189.3	10406.8	7.2	11.0
194.5	390	58327.7	10433.6	7.2	11.0
195.0	391	58466.1	10460.4	7.2	11.0
195.5	392	58604.4	10487.3	7.2	11.0
196.0	393	58742.8	10514.1	7.2	11.0
196.5	394	58881.2	10540.9	7.2	11.0
197.0	395	59019.6	10567.7	7.2	11.0
197.5	396	59157.9	10594.5	7.2	11.0
198.0	397	59296.3	10621.4	7.2	11.0
198.5	398	59434.7	10648.2	7.2	11.0

199.0	399	59573.1	10675.0	7.2	11.0
199.5	400	59711.4	10701.8	7.2	11.0
200.0	401	59849.8	10728.7	7.2	11.0
200.5	402	59988.2	10755.5	7.2	11.0
201.0	403	60126.5	10782.3	7.2	11.0
201.5	404	60264.9	10809.1	7.2	11.0
202.0	405	60403.3	10835.9	7.2	11.0
202.5	406	60541.7	10862.8	7.2	11.0
203.0	407	60680.0	10889.6	7.2	11.0
203.5	408	60818.4	10916.4	7.2	11.0
204.0	409	60956.8	10943.2	7.2	11.0
204.5	410	61095.2	10970.0	7.2	11.0
205.0	411	61233.5	10996.9	7.2	11.0
205.5	412	61371.9	11023.7	7.2	11.0
206.0	413	61510.3	11050.5	7.2	11.0
206.5	414	61648.7	11077.3	7.2	11.0
207.0	415	61787.0	11104.2	7.2	11.0
207.5	416	61925.4	11131.0	7.2	11.0
208.0	417	62063.8	11157.8	7.2	11.0
208.5	418	62202.2	11184.6	7.2	11.0
209.0	419	62340.5	11211.4	7.2	11.0
209.5	420	62478.9	11238.3	7.2	11.0
210.0	421	62617.3	11265.1	7.2	11.0
210.5	422	62755.7	11291.9	7.2	11.0
211.0	423	62894.0	11318.7	7.2	11.0
211.5	424	63032.4	11345.6	7.2	11.0
212.0	425	63170.8	11372.4	7.2	11.0
212.5	426	63309.2	11399.2	7.2	11.0
213.0	427	63447.5	11426.0	7.2	11.0
213.5	428	63585.9	11452.8	7.2	11.0
214.0	429	63724.3	11479.7	7.2	11.0
214.5	430	63862.7	11506.5	7.2	11.0
215.0	431	64001.0	11533.3	7.2	11.0
215.5	432	64139.4	11560.1	7.2	11.0
216.0	433	64277.8	11586.9	7.2	11.0
216.5	434	64416.2	11613.8	7.2	11.0
217.0	435	64554.5	11640.6	7.2	11.0
217.5	436	64692.9	11667.4	7.2	11.0
218.0	437	64831.3	11694.2	7.2	11.0
218.5	438	64969.7	11721.1	7.2	11.0
219.0	439	65108.0	11747.9	7.2	11.0
219.5	440	65246.4	11774.7	7.2	11.0
220.0	441	65384.8	11801.5	7.2	11.0
220.5	442	65523.2	11828.3	7.2	11.0
221.0	443	65661.5	11855.2	7.2	11.0
221.5	444	65799.9	11082.0	7.2	11.0
222.0	445	65938.3	11908.8	7.2	11.0
222.5	446	66076.7	11935.6	7.2	11.0
223.0	447	66215.0	11962.4	7.2	11.0
223.5	448	66353.4	11989.3	7.2	11.0
224.0	449	66491.8	12016.1	7.2	11.0
224.5	450	66630.2	12042.9	7.2	11.0

225.0	451	66768.5	12069.7	7.2	11.0
225.5	452	66906.9	12096.6	7.2	11.0
226.0	453	67045.3	12123.4	7.2	11.0
226.5	454	67183.6	12150.2	7.2	11.0
227.0	455	67322.0	12177.0	7.2	11.0
227.5	456	67460.4	12203.8	7.2	11.0
228.0	457	67598.8	12230.7	7.2	11.0
228.5	458	67737.1	12257.5	7.2	11.0
229.0	459	67875.5	12284.3	7.2	11.0
229.5	460	68013.9	12311.1	7.2	11.0
230.0	461	68152.3	12338.0	7.2	11.0
230.5	462	68290.6	12364.8	7.2	11.0
231.0	463	68429.0	12391.6	7.2	11.0
231.5	464	68567.4	12418.4	7.2	11.0
232.0	465	68705.8	12445.2	7.2	11.0
232.5	466	68844.1	12472.1	7.2	11.0
233.0	467	68982.5	12498.9	7.2	11.0
233.5	468	69120.9	12525.7	7.2	11.0
234.0	469	69259.3	12552.5	7.2	11.0
234.5	470	69397.6	12579.3	7.2	11.0
235.0	471	69536.0	12606.2	7.2	11.0
235.5	472	69674.4	12633.0	7.2	11.0
236.0	473	69812.8	12659.8	7.2	11.0
236.5	474	69951.1	12686.6	7.2	11.0
237.0	475	70089.5	12713.5	7.2	11.0
237.5	476	70227.9	12740.3	7.2	11.0
238.0	477	70366.3	12767.1	7.2	11.0
238.5	478	70504.6	12793.9	7.2	11.0
239.0	479	70643.0	12820.7	7.2	11.0
239.5	480	70781.4	12847.6	7.2	11.0
240.0	481	70919.8	12874.4	7.2	11.0
240.5	482	71058.1	12901.2	7.2	11.0
241.0	483	71196.5	12928.0	7.2	11.0
241.5	484	71334.9	12954.8	7.2	11.0
242.0	485	71473.3	12981.7	7.2	11.0
242.5	486	71611.6	13008.5	7.2	11.0
243.0	487	71750.0	13035.3	7.2	11.0
243.5	488	71888.4	13062.1	7.2	11.0
244.0	489	72026.8	13089.0	7.2	11.0
244.5	490	72165.1	13115.8	7.2	11.0
245.0	491	72303.5	13142.6	7.2	11.0
245.5	492	72441.9	13169.4	7.2	11.0
246.0	493	72580.3	13196.2	7.2	11.0
246.5	494	72718.6	13223.1	7.2	11.0
247.0	495	72857.0	13249.9	7.2	11.0
247.5	496	72995.4	13276.7	7.2	11.0
248.0	497	73133.8	13303.5	7.2	11.0
248.5	498	73272.1	13330.4	7.2	11.0
249.0	499	73410.5	13357.2	7.2	11.0
249.5	500	73548.9	13384.0	7.2	11.0

LEAR36/TFE731 NOISE PREDICTION AT FAR36 SIDELINE CONDITION

NOISE SOURCE= FANI ** DISTANCE = 100.0 ** ONE-THIRD OCTAVE BAND AND OVERALL ENGINE COMPONENT SOURCE NOISE LEVEL SUMMARY

1/3 OCTAVE BAND CENTER FREQUENCY	SOUND PRESSURE LEVEL,DB MIKE LOCATIONS IN DEGREES 10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.	SOUND POWER LEVEL,DB
20.0	27.2	28.6	30.0	31.3	31.1	30.9	30.7	28.0	25.3	24.2	23.1	22.0	20.8	19.8	18.8	17.8	78.2
25.0	30.1	31.5	32.9	34.2	34.0	33.8	33.6	30.9	28.2	27.1	26.0	24.9	23.8	22.8	21.8	20.8	81.1
31.5	33.0	34.4	35.8	37.1	37.0	36.8	36.6	33.9	31.3	30.1	29.1	28.0	27.0	25.9	24.9	23.9	84.1
40.0	36.0	37.4	38.8	40.2	40.0	39.9	39.7	37.1	34.4	33.3	32.1	31.0	29.9	28.9	27.8	26.8	87.1
50.0	39.1	40.5	41.9	43.3	43.1	42.9	42.7	40.0	37.3	36.2	35.1	34.0	32.9	31.9	30.9	29.9	90.2
63.0	42.0	43.5	44.9	46.2	46.1	45.9	45.7	43.1	40.4	39.3	38.2	37.2	36.1	35.1	34.1	33.1	93.2
80.0	45.1	46.5	47.9	49.3	49.2	49.0	48.9	46.3	43.6	42.5	41.4	40.3	39.2	38.2	37.1	36.1	96.3
100.0	48.3	49.7	51.1	52.5	52.4	52.2	52.0	49.3	46.7	45.3	44.5	43.4	42.3	41.2	40.2	39.2	99.5
125.0	51.4	52.8	54.2	55.6	55.4	55.3	55.1	52.4	49.8	48.7	47.7	46.7	45.8	44.8	43.8	42.8	102.6
160.0	54.4	55.9	57.3	58.7	58.6	58.6	58.5	56.0	53.4	52.3	51.3	50.2	49.2	48.2	47.2	46.2	105.9
200.0	58.0	59.4	60.9	62.3	62.2	62.1	62.0	59.3	56.7	55.7	54.7	53.7	52.6	51.7	50.7	49.7	109.4
250.0	61.4	62.8	64.3	65.7	65.6	65.5	65.4	62.9	60.3	59.3	58.4	57.4	56.4	55.5	54.5	53.6	112.9
315.0	64.8	66.3	67.8	69.3	69.2	69.2	69.2	66.7	64.2	63.3	62.4	61.5	60.6	59.7	58.8	57.8	116.7
400.0	68.7	70.2	71.7	73.2	73.2	73.3	73.4	70.9	68.5	67.6	66.7	65.7	64.8	63.9	63.0	62.0	120.8
500.0	72.9	74.4	75.9	77.5	77.5	77.5	77.5	75.1	72.7	71.8	70.9	70.1	69.8	68.8	67.7	66.7	125.0
630.0	77.1	78.6	80.1	81.7	81.8	81.8	82.5	79.9	77.2	75.9	74.5	73.1	71.1	69.8	68.6	67.5	129.3
800.0	81.9	83.4	84.7	86.0	85.7	85.2	83.9	80.9	77.9	76.7	75.5	74.4	73.4	72.3	71.3	70.4	132.2
1000.0	82.9	84.3	85.5	86.8	86.5	86.2	86.1	83.5	80.9	79.9	78.9	78.0	77.8	76.7	75.6	74.5	133.9
1250.0	85.5	87.0	88.4	89.8	89.8	89.8	90.6	87.8	84.8	83.3	81.7	80.0	77.4	75.9	74.6	73.4	137.4
1600.0	89.8	91.2	92.4	93.5	93.0	92.2	90.2	86.8	83.6	82.0	80.6	79.2	78.2	77.0	75.9	74.8	139.3
2000.0	89.1	90.3	91.3	92.3	91.8	91.2	91.0	88.1	85.2	84.0	82.8	81.6	81.2	80.0	78.8	77.6	139.1
2500.0	90.3	91.6	92.9	94.1	93.8	93.5	94.0	91.0	87.8	86.0	84.1	82.1	79.5	77.8	76.2	74.8	141.3
3150.0	93.2	94.4	95.5	96.4	95.6	94.5	92.4	88.5	84.7	82.4	80.2	78.2	76.2	74.5	72.9	71.5	142.0
4000.0	91.2	92.3	92.9	93.4	92.1	90.7	88.7	85.0	81.5	79.5	77.3	75.2	73.4	71.5	69.9	68.4	139.0
5000.0	88.8	89.9	90.7	91.6	90.9	90.2	91.0	87.8	83.3	79.0	75.4	72.5	70.1	68.3	66.7	65.3	138.6
6300.0	96.1	97.4	97.2	96.7	94.7	91.8	85.9	81.0	76.2	73.2	70.8	68.6	66.6	64.9	63.3	62.0	142.0
8000.0	90.2	90.7	90.0	89.3	86.7	84.0	81.7	77.9	74.2	71.4	68.7	66.2	64.3	62.1	60.3	58.7	135.4
10000.0	88.8	89.7	89.7	89.7	87.9	86.0	86.1	83.1	78.6	73.5	68.3	63.9	60.2	58.3	56.6	55.2	136.8
12500.0	92.8	93.9	93.6	93.1	91.0	87.9	81.4	76.4	71.4	67.0	63.0	59.8	57.7	55.1	53.0	51.3	140.1
16000.0	88.3	88.9	88.4	87.8	85.2	82.5	81.6	78.4	73.9	68.9	63.5	58.4	54.0	51.0	48.7	47.0	136.7
20000.0	88.4	89.5	89.3	89.1	87.4	85.5	79.8	75.7	70.6	65.2	59.5	54.2	50.0	46.8	44.5	42.8	139.1

ORIGINAL PAGE IS
OF POOR QUALITY

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OA(20-20K)																	
LINEAR	102.3	103.4	103.8	104.2	103.1	101.9	100.8	97.5	94.1	92.2	90.4	88.8	87.3	85.9	84.6	83.4	150.8
A-SCALE	102.0	103.2	103.8	104.4	103.4	102.4	101.4	98.2	94.8	92.9	91.2	89.5	88.0	86.6	85.3	84.1	150.6
++++++++++																	
OA(50-10K)																	
LINEAR	101.4	102.5	103.1	103.6	102.6	101.6	100.6	97.4	94 0	92.1	90.4	88.7	87.3	85.9	84.6	83.4	149.8
A-SCALE	101.7	103.0	103.6	104.2	103.3	102.3	101.4	98.2	94.8	92.9	91.2	89.5	88.0	86.6	85.3	84.1	150.4
++++++++++																	
PERCEIVED NOISE LEVL																	
PNL	114.5	115.7	116.2	117.0	116.1	115.1	113.8	110.7	107.3	105.4	103.4	101.6	99.5	98.1	96.8	95.5	
PNLTC	115.6	116.9	117.3	118.3	117.7	116.7	115.3	112.3	108.4	106.0	104.0	102.1	100.1	98.6	97.4	96.2	

*****STATIC LEVELS AT AMBIENT CORRECTED TO FAA STD DAY CONDITIONS (77 DEG F, 70 PCT RH) FOR FLYOVER PREDICTIONS ONLY

LEAR36/TFE731 NOISE PREDICTION AT FAR36 SIDELINE CONDITION

NOISE SOURCE= FAND ** DISTANCE = 100.0 ** ONE-THIRD OCTAVE BAND AND OVERALL ENGINE COMPONENT SOURCE NOISE LEVEL SUMMARY

1/3 OCTAVE BAND CENTER FREQUENCY	SOUND PRESSURE LEVEL,DB MIKE LOCATIONS IN DEGREES 10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.	SOUND POWER LEVEL,DB
20.0	5.9	5.6	5.2	4.7	4.0	3.3	2.5	1.8	1.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	52.7
25.0	5.9	5.6	5.2	4.7	4.0	3.3	2.5	1.8	1.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	52.7
31.5	5.9	5.6	5.2	4.7	4.0	3.3	2.5	1.8	1.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	52.7
40.0	5.9	5.6	5.2	4.7	4.0	3.3	2.5	1.8	1.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	52.7
50.0	5.9	5.6	5.2	4.7	4.0	3.3	2.5	1.8	1.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	52.7
63.0	5.9	5.6	5.2	4.7	4.0	3.3	2.5	1.8	1.1	0.5	0.1	0.0	0.0	0.0	0.0	0.0	52.8
80.0	5.9	5.6	5.2	4.7	4.0	3.3	2.6	1.9	1.6	1.7	2.1	2.5	2.6	1.5	0.0	0.0	53.3
100.0	5.8	5.6	5.2	4.7	4.0	3.4	2.9	3.0	3.9	5.4	6.8	7.9	8.5	7.0	3.9	1.3	55.9
125.0	5.8	5.6	5.2	4.7	4.2	4.1	4.5	6.4	9.1	11.7	13.7	15.1	16.1	14.5	11.0	7.4	61.7
160.0	5.8	5.6	5.3	5.0	5.1	6.4	9.5	13.0	16.4	19.1	21.1	22.4	23.1	21.4	17.7	13.9	68.6
200.0	5.9	5.7	5.7	6.3	8.1	11.4	15.7	19.6	23.0	25.8	27.7	29.0	29.6	27.9	24.1	20.3	75.1
250.0	6.1	6.3	7.3	9.5	13.1	17.4	22.1	26.0	29.4	32.2	34.1	35.3	35.9	34.2	30.4	26.5	81.4
315.0	6.9	8.3	10.9	14.7	19.0	23.6	28.4	32.3	35.7	38.4	40.3	41.5	42.2	40.4	36.6	32.7	87 7
400.0	9.4	12.4	16.2	20.6	25.2	29.8	34.6	38.5	41.8	44.4	46.1	47.2	47.7	45.8	42.0	38.0	93.4
500.0	13.9	17.8	22.1	26.5	31.1	35.6	40.1	43.9	47.1	49.7	51.4	52.4	52.9	51.1	47.1	43.2	98.7
630.0	18.8	23.0	27.4	31.8	36.3	40.8	45.4	49.1	52.3	54.8	56.4	57.5	58.0	56.1	52.2	48.2	103.8
800.0	23.8	28.1	32.5	36.9	41.4	45.9	50.5	54.1	57.2	59.6	61.2	62.1	62.4	60.5	56.5	52.5	108.4
1000.0	28.8	33.1	37.5	41.8	46.2	50.5	54.9	58.4	61.4	63.8	65.2	66.1	66.4	64.4	60.4	56.4	112.5
1250.0	33.1	37.4	41.7	46.0	50.3	54.6	58.9	62.3	65.3	67.6	69.1	70.0	70.4	66.4	64.3	60.3	116.5
1600.0	37.0	41.3	45.6	49.9	54.1	58.4	62.8	66.3	69.2	71.4	72.8	73.6	73.7	71.6	67.5	63.5	120.1
2000.0	40.9	45.2	49.4	53.7	57.9	62.0	66.2	69.5	72.3	74.4	75.7	76.5	76.6	74.5	70.4	66.3	123.2
2500.0	44.1	48.4	52.6	56.7	60.9	65.0	69.0	72.3	75.1	77.1	78.4	79.1	79.2	77.0	72.9	68.8	125.9
3150.0	46.9	51.1	55.3	59.4	63.5	67.6	71.6	74.8	77.5	79.5	80.7	81.4	80.2	78.2	74.3	70.5	128.1
4000.0	49.4	53.6	57.7	61.8	65.8	69.8	72.0	75.8	79.6	83.0	85.4	87.0	90.9	88.9	85.3	81.5	135.2
5000.0	50.0	54.6	59.5	64.7	70.2	76.0	85.9	89.1	91.7	92.9	92.4	91.2	87.0	83.8	79.1	74.5	139.8
6300.0	65.6	69.5	73.3	76.8	80.1	82.8	80.4	81.4	82.5	83.4	84.1	84.6	85.2	83.0	78.8	74.7	133.7
8000.0	56.5	59.9	63.0	65.9	69.1	72.5	77.1	80.3	83.2	85.6	87.1	87.9	89.4	87.2	83.3	79.4	136.1
10000.0	54.3	58.6	62.9	67.4	71.9	76.5	83.2	86.2	88.6	89.9	89.8	89.1	86.8	84.0	79.5	75.2	138.6
12500.0	61.7	65.6	69.4	73.0	76.3	79.1	79.1	81.0	82.8	84.4	85.4	85.9	87.0	84.7	80.6	76.6	136.1
16000.0	54.7	58.5	62.1	65.7	69.5	73.5	79.3	82.2	84.7	86.1	86.4	86.1	85.2	82.6	78.2	74.1	137.5
20000.0	56.3	60.4	64.6	68.7	72.8	76.8	77.6	79.8	81.8	82.9	83.2	83.1	82.6	80.0	75.6	71.4	136.2

++++++++++																	
OA(20-20K)																	
LINEAR	68.4	72.3	76.1	79.8	83.3	86.7	90.1	92.9	95.4	96.8	97.0	96.8	96.7	94.4	90.3	86.4	146.2
A-SCALE	67.1	71.0	74.8	78.4	82.0	85.3	89.1	92.0	94.5	96.0	96.2	96.0	96.0	93.8	89.8	85.9	144.7
++++++++++																	
OA(50-10K)																	
LINEAR	66.7	70.6	74.4	78.0	81.6	84.9	89.0	92.0	94.5	95.9	96.1	95.8	95.6	93.4	89.4	85.4	144.4
A-SCALE	66.5	70.3	74.2	77.8	81.4	84.7	88.8	91.7	94.3	95.7	95.9	95.7	95.7	93.5	89.5	85.6	144.2
++++++++++																	
PERCEIVED NOISE LEVL																	
PNL	79.1	83.0	86.9	90.6	94.1	97.4	101.5	104.6	107.2	108.7	108.8	108.3	108.6	106.6	102.7	98.9	
PNLTC	81.2	85.1	88.9	92.6	96.5	99.7	104.7	108.1	110.7	111.9	110.5	109.5	111.1	109.2	105.6	101.9	

*****STATIC LEVELS AT AMBIENT CORRECTED TO FAA STD DAY CONDITIONS (77 DEG F, 70 PCT RH) FOR FLYOVER PREDICTIONS ONLY

LEAR36/TFE731 NOISE PREDICTION AT FAR36 SIDELINE CONDITION

NOISE SOURCE= COMB ** DISTANCE = 100.0 ** ONE-THIRD OCTAVE BAND AND OVERALL ENGINE COMPONENT SOURCE NOISE LEVEL SUMMARY

1/3 OCTAVE BAND CENTER FREQUENCY	SOUND PRESSURE LEVEL,DB MIKE LOCATIONS IN DEGREES 10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.	SOUND POWER LEVEL,DB
20.0	35.9	37.6	39.3	40.9	42.9	44.1	45.3	46.6	48.5	50.2	51.2	51.9	52.1	52.2	52.1	52.1	99.8
25.0	39.9	41.7	43.3	45.0	46.9	48.2	49.3	50.6	52.5	54.2	55.3	56.0	56.2	56.3	56.2	56.3	103.8
31.5	44.0	45.7	47.3	49.0	50.9	52.2	53.4	54.8	56.7	58.4	59.5	60.3	60.5	60.7	60.6	60.7	108.1
40.0	48.1	49.8	51.5	53.2	55.2	56.5	57.8	59.1	61.1	62.8	63.8	64.6	64.8	64.9	64.8	64.8	112.4
50.0	52.5	54.2	55.8	57.5	59.5	60.8	62.1	63.3	65.2	66.8	67.7	68.3	68.4	68.4	68.2	68.2	116.2
63.0	56.7	58.4	60.0	61.6	63.5	64.6	65.6	66.8	68.6	70.1	71.1	71.7	71.8	71.9	71.7	71.7	119.6
80.0	60.1	61.8	63.4	65.0	66.8	68.0	69.1	70.2	72.0	73.6	74.5	75.1	75.3	75.3	75.1	75.0	123.0
100.0	63.6	65.3	66.8	68.4	70.2	71.4	72.5	73.6	75.3	76.7	77.5	78.0	77.9	77.9	77.6	77.5	126.0
125.0	67.0	68.7	70.2	71.7	73.4	74.4	75.2	76.2	77.8	79.2	80.0	80.5	80.5	80.5	80.3	80.2	128.6
160.0	69.6	71.2	72.7	74.1	75.8	76.8	77.8	78.8	80.5	81.9	82.6	83.1	83.2	83.1	82.8	82.7	131.2
200.0	72.2	73.9	75.3	76.8	78.5	79.5	80.5	81.4	82.9	84.2	84.8	85.1	84.9	84.7	84.3	84.2	133.3
250.0	74.8	76.4	77.8	79.2	80.8	81.6	82.2	82.9	84.3	85.5	86.0	86.3	86.2	86.0	85.6	85.4	134.7
315.0	76.3	77.9	79.2	80.5	82.0	82.7	83.5	84.2	85.4	86.4	86.7	86.7	86.2	85.8	85.3	85.0	135.3
400.0	77.6	[illegible]	80.4	81.5	82.8	83.3	83.6	84.0	84.9	85.7	85.8	85.7	85.1	84.6	84.0	83.7	134.8
500.0	77.4	[illegible]	79.9	80.9	82.1	82.4	82.4	82.7	83.5	84.2	84.3	84.1	83.6	83.1	82.4	82.1	133.5
630.0	76.2	77.5	78.6	79.5	80.5	80.8	81.0	81.2	81.9	82.5	82.5	82.2	81.4	80.8	80.1	79.7	131.8
800.0	74.6	76.0	77.0	77.9	78.8	78.9	78.8	78.8	79.5	79.9	79.8	79.5	78.7	78.1	77.4	77.0	129.4
1000.0	72.3	73.6	74.6	75.3	76.2	76.3	76.1	76.1	76.7	77.1	77.0	76.7	76.0	75.4	74.6	74.2	126.8
1250.0	69.6	70.9	71.3	72.6	73.4	73.4	73.4	73.4	73.9	74.3	74.0	73.6	72.5	71.8	71.0	70.5	123.8
1600.0	66.8	68.1	69.0	69.7	70.4	70.4	69.9	69.7	70.1	70.3	70.0	69.5	68.6	67.8	67.0	66.6	120.3
2000.0	63.2	64.4	65.2	65.8	66.5	66.4	66.0	65.8	66.2	66.4	66.2	65.8	65.0	64.3	63.5	63.1	116.5
2500.0	59.2	60.4	61.3	61.9	62.6	62.5	62.4	62.2	62.7	63.0	62.8	62.4	61.6	60.9	60.1	59.6	113.1
3150.0	55.6	56.9	57.7	58.4	59.1	59.1	58.9	58.7	59.2	59.4	59.1	58.6	57.6	56.9	56.0	55.5	109.6
4000.0	52.1	53.4	54.2	54.8	55.5	55.4	54.9	54.7	55.0	55.2	54.9	54.4	53.5	52.7	51.8	51.3	105.7
5000.0	48.1	49.3	50.1	50.7	51.3	51.2	50.8	50.6	50.9	51.1	50.7	50.2	49.3	48.5	47.6	47.1	101.7
6300.0	43.9	45.1	45.9	46.4	47.0	46.8	46.5	46.2	46.5	46.6	46.2	45.5	44.4	43.5	42.6	42.1	97.5
8000.0	39.4	40.6	41.3	41.8	42.4	42.1	41.5	41.1	41.3	41.3	40.8	40.2	39.2	38.3	37.4	36.8	92.8
10000.0	34.1	35.3	36.0	36.4	36.9	36.6	36.1	35.7	35.9	35.9	35.5	34.8	33.9	33.0	32.1	31.5	88.0
12500.0	28.4	29.6	30.3	30.8	31.3	30.9	30.5	30.1	30.2	30.2	29.6	28.8	27.5	26.5	25.5	24.9	83.1
16000.0	22.3	23.4	24.1	24.5	24.9	24.5	23.6	23.0	23.0	22.9	22.3	21.6	20.5	19.6	18.6	18.0	77.7
20000.0	15.3	16.4	17.0	17.4	17.7	17.2	16.7	16.2	16.2	16.1	15.6	14.8	13.7	12.7	11.8	11.2	72.0

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OA(20-20K)																	
LINEAR	85.1	86.6	87.8	88.9	90.2	90.8	91.2	91.7	92.0	93.8	94.1	94.2	93.8	93.5	93.0	92.8	143.0
A-SCALE	81.8	83.2	84.2	85.2	86.3	86.6	86.8	87.0	87.9	88.6	88.7	88.6	88.0	87.5	86.9	86.6	137.9
++++++++++																	
OA(50-10K)																	
LINEAR	85.1	86.6	87.8	88.9	90.2	90.8	91.2	91.7	92.8	93.8	94.1	94.2	93.8	93.5	93.0	92.8	143.0
A-SCALE	81.8	83.2	84.2	85.2	86.3	86.6	86.8	87.0	87.9	88.6	88.7	88.6	88.0	87.5	86.9	86.6	137.9
++++++++++																	
PERCEIVED NOISE LEVL																	
PNL	91.2	92.7	93.9	94.9	96.2	96.6	96.8	97.2	98.1	98.9	99.1	99.0	98.4	98.0	97.4	97.1	
PNLTC	91.3	92.8	94.0	95.1	96.3	96.7	96.9	97.3	98.3	99.0	99.2	99.1	98.5	98.1	97.5	97.2	

*****STATIC LEVELS AT AMBIENT CORRECTED TO FAA STD DAY CONDITIONS (77 DEG F, 70 PCT RH) FOR FLYOVER PREDICTIONS ONLY

ORIGINAL PAGE IS
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NASA LEWIS RESEARCH CENTER
NASA GASP NOISE MODULE OUTPUT

LEAR36/TFE731 NOISE PREDICTION AT FAR36 SIDELINE CONDITION

NOISE SOURCE= JET ** DISTANCE = 100.0 ** ONE-THIRD OCTAVE BAND AND OVERALL ENGINE COMPONENT SOURCE NOISE LEVEL SUMMARY

1/3 OCTAVE BAND CENTER FREQUENCY	SOUND PRESSURE LEVEL,DB MIKE LOCATIONS IN DEGREES 10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.	SOUND POWER LEVEL,DB
20.0	61.9	62.3	62.7	63.1	63.6	64.3	65.0	65.9	66.9	68.1	69.6	72.0	75.8	78.9	81.4	84.2	125.2
25.0	64.2	64.5	64.9	65.3	65.9	66.5	67.2	68.1	69.2	70.4	71.9	74.4	78.8	82.2	84.7	86.8	128.0
31.5	66.6	66.9	67.3	67.8	68.3	68.9	69.6	70.5	71.5	72.8	74.2	76.9	81.8	85.8	87.9	89.2	130.9
40.0	68.9	69.2	69.6	70.0	70.6	71.2	71.9	72.8	73.9	75.1	76.6	79.3	84.7	89.3	90.8	91.6	133.7
50.0	71.0	71.4	71.7	72.2	72.7	73.3	74.1	75.0	76.0	77.3	78.7	81.6	87.6	92.1	92.8	93.3	136.0
63.0	73.3	73.7	74.0	74.5	75.0	75.6	76.4	77.3	78.3	79.5	81.0	84.1	90.5	94.3	94.4	94.7	137.9
80.0	75.5	75.8	76.1	76.5	77.1	77.7	78.5	79.4	80.5	81.7	83.2	86.4	92.4	95.9	96.1	95.9	139.6
100.0	77.1	77.3	77.7	78.1	78.6	79.3	80.1	81.0	82.1	83.4	85.0	88.2	93.7	97.0	97.6	96.7	140.8
125.0	78.4	78.6	78.8	79.3	79.8	80.4	81.3	82.2	83.4	84.7	86.4	89.8	95.0	97.9	98.6	97.1	141.8
160.0	79.5	79.7	79.9	80.3	80.9	81.5	82.4	83.3	84.5	85.9	87.7	91.4	96.1	98.7	99.2	96.6	142.4
200.0	80.4	80.5	80.8	81.2	81.7	82.4	83.2	84.2	85.4	86.8	88.8	92.5	96.4	98.7	98.8	95.5	142.5
250.0	81.1	81.2	81.5	81.9	82.4	83.1	83.9	84.9	86.1	87.5	89.6	93.2	96.2	98.0	97.5	93.8	142.1
315.0	81.7	81.8	82.0	82.4	82.9	83.6	84.4	85.5	86.7	88.1	90.2	93.4	95.7	97.0	95.8	91.8	141.4
400.0	82.0	82.1	[illegible]	82.7	83.2	83.9	84.8	85.8	87.1	88.5	90.5	93.1	94.7	95.5	93.9	89.8	140.6
500.0	82.2	82.3	82.5	82.9	83.4	84.1	85.0	86.0	87.3	88.7	90.5	92.5	93.4	93.9	92.1	87.9	139.9
630.0	82.2	82.2	82.4	82.8	83.3	84.0	84.9	86.0	87.3	88.7	90.4	91.8	92.0	92.2	90.2	85.8	139.1
800.0	82.1	82.1	82.3	82.7	83.2	83.9	84.8	85.9	87.2	88.6	90.2	90.9	90.6	90.4	88.3	83.8	138.3
1000.0	81.8	81.8	81.9	82.3	82.8	83.5	84.4	85.5	86.8	88.3	89.7	90.0	89.2	88.8	86.5	81.9	137.6
1250.0	81.2	81.2	81.4	81.7	82.2	83.0	83.9	85.0	86.3	87.8	89.1	89.0	87.8	87.2	84.7	79.9	136.7
1600.0	80.5	80.5	80.6	81.0	81.5	82.2	83.1	84.3	85.6	87.1	88.3	87.8	86.3	85.4	82.8	77.8	135.8
2000.0	79.8	79.8	79.9	80.3	80.8	81.5	82.5	83.6	84.9	86.4	87.5	86.7	85.0	83.8	81.0	75.9	135.0
2500.0	79.0	79.0	79.1	79.4	79.9	80.7	81.6	82.8	84.1	85.6	86.7	85.6	83.6	82.2	79.2	74.0	134.1
3150.0	78.0	78.0	78.1	78.4	78.9	79.7	80.6	81.8	83.1	84.7	85.6	84.4	82.2	80.5	77.4	72.0	133.1
4000.0	76.9	76.8	76.9	77.3	77.8	78.5	79.5	80.7	82.0	83.5	84.5	83.2	80.7	78.7	75.5	69.9	132.1
5000.0	75.9	75.8	75.9	76.2	76.7	77.5	78.4	79.6	80.9	82.5	83.4	82.0	79.4	77.1	73.7	68.0	131.1
6300.0	74.8	74.7	74.8	75.1	75.6	76.4	77.3	78.5	79.8	81.4	82.3	80.7	78.0	75.4	71.8	66.0	130.1
8000.0	73.5	73.4	73.5	73.8	74.4	75.1	76.1	77.3	78.6	80.2	81.1	79.5	76.5	73.7	69.9	63.9	129.3
10000.0	72.4	72.3	72.4	72.7	73.2	74.0	74.9	76.1	77.5	79.0	79.9	78.3	75.2	72.1	68.1	62.0	128.6
12500.0	71.3	71.2	71.3	71.6	72.1	72.9	73.8	75.0	76.4	77.9	78.8	77.1	73.8	70.5	66.4	60.1	128.3
16000.0	70.0	69.9	70.0	70.3	70.9	71.6	72.6	73.7	75.1	76.7	77.5	75.7	72.3	68.7	64.4	58.0	125.4
20000.0	68.9	68.8	68.9	69.2	69.7	70.4	71.4	72.6	73.9	75.5	76.4	74.6	70.9	67.0	62.6	56.0	128.5

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OA(20-20K)																	
LINEAR	93.3	93.4	93.6	94.0	94.5	95.2	96.1	97.1	98.4	99.8	101.4	103.2	105.6	107.7	107.5	105.4	152.6
A-SCALE	91.4	91.4	91.5	91.9	92.4	93.1	94.0	95.1	96.4	97.9	99.3	99.7	99.7	100.1	98.6	94.6	147.8
++++++++++																	
OA(50-10K)																	
LINEAR	93.3	93.3	93.5	93.9	94.4	95.1	96.0	97.0	98.3	99.7	101.3	103.1	105.6	107.5	107.3	105.3	152.4
A-SCALE	91.4	91.3	91.5	91.8	92.4	93.1	94.0	95.1	96.4	97.9	99.3	99.7	99.7	100.1	98.6	94.6	147.7
++++++++++																	
PERCEIVED NOISE LEVL																	
PNL	104.2	104.2	104.4	104.7	105.2	106.0	106.9	108.0	109.3	110.8	112.1	112.2	112.4	113.1	112.0	108.5	
PNLTC	104.2	104.2	104.4	104.7	105.3	106.0	106.9	108.0	109.3	110.8	112.1	112.3	112.5	113.1	112.0	108.5	

*****STATIC LEVELS AT AMBIENT CORRECTED TO FAA STD DAY CONDITIONS (77 DEG F, 70 PCT RH) FOR FLYOVER PREDICTIONS ONLY

ORIGINAL PAGE IS OF POOR QUALITY

LEAM36/TFE731 NOISE PREDICTION AT FAR36 SIDELINE CONDITION

NOISE SOURCE= ATUR ** DISTANCE = 100.0 ** ONE-THIRD OCTAVE BAND AND OVERALL ENGINE COMPONENT SOURCE NOISE LEVEL SUMMARY

1/3 OCTAVE BAND CENTER FREQUENCY	SOUND PRESSURE LEVEL,DB MIKE LOCATIONS IN DEGREES 10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.	SOUND POWER LEVEL,DB
20.0	45.2	46.0	46.7	47.2	47.8	48.2	48.6	49.0	49.4	53.4	55.4	54.3	50.5	45.7	41.4	39.2	101.1
25.0	46.1	46.9	47.6	48.2	48.7	49.2	49.6	50.0	50.4	54.4	56.3	55.3	51.5	46.7	42.4	40.2	102.1
31.5	47.1	47.9	48.6	49.2	49.7	50.2	50.6	51.0	51.4	55.4	57.4	56.3	52.5	47.7	43.4	[illegible]	103.1
40.0	48.1	48.9	49.6	50.2	50.7	51.2	51.6	52.0	52.5	56.4	58.4	57.3	53.5	48.7	44.4	[illegible]	104.1
50.0	49.1	49.9	50.6	51.2	51.7	52.2	52.6	53.0	53.4	57.4	59.4	58.3	54.5	49.7	45.4	43.2	105.1
63.0	50.1	50.9	51.6	52.2	52.7	53.2	53.6	54.0	54.4	58.4	60.4	59.3	55.6	50.7	46.5	44.3	106.1
80.0	51.1	51.9	52.6	53.2	53.7	54.2	54.6	55.1	55.5	59.4	61.4	60.4	56.6	51.7	47.5	45.3	107.1
100.0	52.1	53.0	53.6	54.2	54.8	55.2	55.6	56.0	56.5	60.4	62.4	61.3	57.5	52.7	48.4	46.2	108.1
125.0	53.1	54.0	54 6	55.2	55.7	56.2	56.6	57.0	57.4	61.4	63.4	62.3	58.6	53.8	49.5	47.3	109.1
160.0	54.1	54.9	55.6	56.2	56.7	57.2	57.7	58.1	58.5	62.5	64.4	63.4	59.6	54.7	50.5	48.3	110.2
200.0	55.2	56.0	56.7	57.3	57.8	58.3	58.7	59.1	59.5	63.4	65.4	64.4	60.6	55.7	51.5	49.3	111.2
250.0	56.2	57.0	57.7	58.2	58.8	59.2	59.6	60.0	60.5	64.4	66.4	65.4	61.6	56.8	52.5	50.3	112.2
315.0	57.1	57.9	58.6	59.2	59.7	60.2	60.6	61.1	61.5	65.5	67.4	66.4	62.6	57.8	53.5	51.3	113.2
400.0	58.2	59.0	59.7	60.3	60.8	61.3	61.7	62.1	62.6	66.5	68.5	67.4	63.6	58.8	54.5	52.4	114.3
500.0	59.2	60.0	60.7	61.3	61.8	62.3	62.7	63.1	63.5	67.5	69.5	68.4	64.6	59.8	55.6	53.4	115.3
630.0	60.2	61.0	61.7	62.3	62.8	63.3	63.7	64.1	64.6	68.5	70.5	69.5	65.8	61.0	56.7	54.5	116.4
800.0	61.2	62.0	62.7	63.3	63.8	64.3	64.8	65.3	65.7	69.6	71.5	70.4	66.4	61.5	57.2	55.0	117.3
1000.0	62.3	63.1	63.8	64.4	64.8	65.2	65.4	65.8	66.2	70.1	72.0	71.0	67.2	62.4	58.1	55.9	118.0
1250.0	62.8	63.6	64.3	64 9	65.4	65.8	66.3	66.7	67.1	71.1	73.1	72.0	68.3	63.5	59.2	57.0	119.0
1600.0	63.7	64.5	65.2	65.8	66.4	66.8	67.3	67.7	68.2	72.2	74.1	73.1	69.3	64.5	60.2	58.4	120.1
2000.0	64.8	65.6	66.3	66.9	67.4	67.9	68.3	68.7	69.2	73.1	75.1	74.1	70.3	65.5	61.2	59.1	121.2
2500.0	65.7	66.5	67.2	67.9	68.4	68.9	69.3	69.7	70.2	74.2	76.3	75.4	71.6	66.9	62.7	60.6	122.5
3150.0	66.7	67.5	68.2	68.9	69.5	70.1	70.6	71.2	71.8	75.9	78.1	77.2	73.7	69.0	64.9	62.8	124.3
4000.0	68.1	68.9	69.7	70.5	71.2	71.8	72.5	73.2	73.9	78.2	80.4	79.6	76.1	71.5	67.4	65.3	126.7
5000.0	70.2	71.1	71.9	72.7	73.5	74.2	75.1	75.8	76.5	80.7	82.9	82.0	78.3	73.6	69.4	67.3	129.2
6300.0	72.6	73.5	74.3	75.1	75.8	76.5	77.1	77.7	78.3	82.5	84.7	83.8	80.2	75.5	71.4	69.2	131.3
8000.0	74.4	75.3	76.1	76.8	77.5	78.2	78.9	79.5	80.1	84.2	86.4	85.4	81.6	76.9	72.7	70.6	133.4
10000.0	76.1	76.9	77.7	78.4	79.1	79.7	80.2	80.7	81.3	85.5	87.6	86.7	83.1	78.4	74.2	72.1	135.2
12500.0	76.9	77.8	78.6	79.3	80.0	80.7	81.3	81.9	82.6	86.8	89.1	88.3	84.8	80.2	76.1	74.0	137.5
14000.0	77.6	78.5	79.3	80.1	80.9	81.6	82.5	83.2	83.9	88.1	90.4	89.5	85.8	81.1	76.9	74.7	140.1
20000.0	78.9	79.8	80.7	81.5	82.3	83.1	83.5	84.2	84.9	89.1	91.5	90.5	86.7	81.9	77.7	75.5	142.4

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OA(20-20K)																	
LINEAR	84.9	85.8	86.6	87.4	88.1	88.8	89.4	90.1	90.7	94.9	97.1	96.3	92.6	87.8	83.7	81.5	146.3
A-SCALE	81.7	82.5	83.3	84.1	84.7	85.4	86.0	86.6	87.3	91.4	93.6	92.7	89.1	84.3	80.2	76.1	141.4
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OA(50-10K)																	
LINEAR	81.0	81.9	82.7	83.4	84.1	84.7	85.3	85.9	86.5	90.6	92.7	91.8	88.1	83.4	79.3	77.1	139.6
A-SCALE	80.3	81.1	81.9	82.6	83.3	83.9	84.5	85.1,	85.7	89.9	92.0	91.1	87.4	82.7	78.6	76.4	138.8
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PERCEIVED NOISE LEVL																	
PNL	92.9	93.7	94.5	95.2	95.9	96.5	97.1	97.7	98.3	102.4	104.5	103.6	99.9	95.2	91.0	88.9	
PNLTC	92.9	93.8	94.6	95.3	96.0	96.6	97.1	97.7	98.3	102.4	104.6	103.7	100.0	95.3	91.1	88.9	

*****STATIC LEVELS AT AMBIENT CORRECTED TO FAA STD DAY CONDITIONS (77 DEG F, 70 PCT RH) FOR FLYOVER PREDICTIONS ONLY

LEAR36/TFE731 NOISE PREDICTION AT FAR36 SIDELINE CONDITION

NOISE SOURCE= TOTL ** DISTANCE = 100.0 ** ONE-THIRD OCTAVE BAND AND OVERALL ENGINE COMPONENT SOURCE NOISE LEVEL SUMMARY

1/3 OCTAVE BAND CENTER FREQUENCY	SOUND PRESSURE LEVEL,DB — MIKE LOCATIONS IN DEGREES 10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.	SOUND POWER LEVEL,DB
20.0	62.1	62.4	62.8	63.3	63.8	64.4	65.1	66.0	67.1	68.4	69.8	72.1	75.8	78.9	81.4	84.2	125.2
25.0	64.3	64.6	65.9	65.5	66.0	66.6	67.4	68.3	69.3	70.6	72.1	74.5	78.8	82.3	84.7	86.8	128.1
31.5	66.7	67.0	67.4	67.9	68.4	69.1	69.8	70.7	71.7	73.0	74.5	77.0	81.8	85.8	87.9	89.2	131.0
40.0	69.0	69.3	69.7	70.2	70.7	71.4	72.1	73.0	74.1	75.4	76.9	79.5	84.7	89.3	90.8	91.6	133.8
50.0	71.1	71.5	71.9	72.4	72.9	73.6	74.4	75.3	76.4	77.7	79.1	81.8	87.7	92.1	92.9	93.3	136.0
63.0	73.4	73.8	74.2	74.7	75.3	76.0	76.7	77.6	78.8	80.0	81.5	84.4	90.5	94.3	94.5	94.7	138.0
80.0	75.6	76.0	76.4	76.9	77.5	78.2	79.0	79.9	81.1	82.4	83.8	86.7	92.5	95.9	96.2	95.9	139.7
100.0	77.3	77.6	78.0	78.6	79.2	79.9	80.8	81.7	82.9	84.3	85.7	88.6	93.8	97.1	97.6	96.8	140.9
125.0	78.7	79.0	79.4	80.0	80.7	81.4	82.2	83.2	84.4	85.8	87.3	90.3	95.2	98.0	98.7	97.2	142.0
160.0	79.9	80.3	80.7	81.3	82.1	82.8	83.7	84.7	86.0	87.3	88.9	92.0	96.3	98.8	99.3	96.8	142.8
200.0	81.0	81.4	81.9	82.6	83.5	84.2	85.1	86.1	87.4	88.7	90.3	93.2	96.7	98.9	99.0	95.9	143.0
250.0	82.1	82.5	83.1	83.8	84.7	85.5	86.2	87.1	88.3	89.6	91.2	94.0	96.6	98.3	97.8	94.4	142.8
315.0	82.9	83.4	84.0	84.7	85.6	86.3	87.1	87.9	89.1	90.3	91.8	94.3	96.2	97.3	96.1	92.6	142.4
400.0	83.5	84.1	84.7	85.4	86.3	86.8	87.4	88.1	89.2	90.3	91.8	93.9	95.1	95.8	94.3	90.7	141.7
500.0	83.9	84.4	85.0	85.8	86.4	86.9	87.4	87.9	88.9	90.1	91.5	93.1	93.8	94.2	92.5	88.9	140.9
630.0	84.1	84.7	85.5	86.3	86.8	87.2	87.9	88.0	88.7	89.9	91.2	92.3	92.4	92.5	90.7	86.8	140.2
800.0	85.4	86.3	87.2	88.1	88.2	88.2	88.0	87.7	88.3	89.5	90.7	91.4	90.9	90.8	88.7	84.8	139.7
1000.0	85.6	86.5	87.4	88.3	88.3	88.4	88.6	88.0	88.2	89.2	90.4	90.5	89.7	89.3	87.1	83.2	139.4
1250.0	87.0	88.1	89.3	90.5	90.6	90.7	91.5	89.8	88.8	89.4	90.1	89.7	88.4	87.7	85.4	81.2	140.2
1600.0	90.3	91.6	92.7	93.8	93.3	92.6	91.1	88.9	87.9	88.5	89.3	88.7	87.3	86.2	83.8	79.9	141.0
2000.0	89.6	90.7	91.7	92.6	92.1	91.7	91.6	89.5	88.3	88.7	89.2	88.4	87.1	85.7	83.3	80.1	140.6
2500.0	90.6	91.9	93.1	94.3	94.0	93.7	94.3	91.7	89.6	89.3	89.2	88.1	86.2	84.5	81.7	78.1	142.2
3150.0	93.3	94.5	95.6	96.5	95.7	94.7	92.7	89.6	87.6	87.7	88.2	87.3	85.3	83.3	80.2	76.4	142.8
4000.0	91.4	92.4	93.0	93.5	92.3	91.1	89.3	86.9	86.2	87.6	89.0	89.2	91.5	89.5	85.9	82.1	141.3
5000.0	89.0	90.1	90.9	91.8	91.2	90.7	92.4	91.9	92.7	93.7	93.4	92.1	88.2	85.1	80.7	76.4	142.8
6300.0	96.2	97.4	97.2	96.8	95.0	92.5	87.8	86.0	85.8	87.4	88.7	88.2	87.0	84.3	80.3	76.4	143.1
8000.0	90.4	90.9	90.3	89.6	87.5	85.7	85.0	84.9	86.2	88.7	90.3	90.2	90.3	87.8	83.9	80.1	140.2
10000.0	89.1	90.0	90.0	90.1	88.7	87.5	88.8	88.9	90.0	91.6	92.1	91.3	88.5	85.3	80.9	77.1	142.0
12500.0	92.9	94.0	93.8	93.3	91.5	89.2	85.7	85.5	86.3	89.1	90.9	90.5	89.2	86.1	82.0	78.6	143.1
16000.0	88.7	89.4	89.0	88.6	86.8	85.6	86.3	86.7	87.8	90.5	92.0	91.3	88.6	85.0	80.7	77.5	143.3
20000.0	88.9	90.0	89.9	89.9	88.8	87.0	85.9	86.2	86.9	90.2	92.2	91.3	88.2	84.2	79.9	77.0	144.8

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OA(20-20K)																	
LINEAR	102.9	104.0	104.4	104.8	104.0	103.3	102.8	101.8	102.0	103.3	104.4	105.2	106.6	108.1	107.8	105.9	156.1
A-SCALE	102.4	103.6	104.2	104.7	103.9	103.1	102.6	100.9	100.6	101.5	102.3	102.3	101.9	101.4	99.6	96.1	153.5
++++++++++																	
OA(50-10K)																	
LINEAR	102.1	103.2	103.7	104.2	103.5	102.9	102.5	101.5	101.6	102.7	103.6	104.7	106.4	107.9	107.6	105.6	155.2
A-SCALE	102.2	103.3	103.9	104.6	103.8	103.0	102.5	100.8	100.4	101.3	102.0	102.0	101.7	101.3	99.5	96.0	153.2
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PERCEIVED NOISE LEVL																	
PNL	116.0	117.1	117.5	118.3	117.6	116.9	116.2	114.6	114.9	115.9	116.4	116.3	116.7	116.0	113.7	110.5	
PNLTC	117.1	118.2	118.6	119.5	119.1	118.3	117.5	116.4	117.1	117.9	117.4	117.1	118.3	117.7	115.5	112.4	

CONVERGENCE MONITOR SUBROUTINE GOLD1

N	Y1	Y2	X1	X2
2	0.8791494D+02	0.8643992D+02	0.1089029D+05	0.1483971D+05
3	0.8805644D+02	0.8791494D+02	0.8449417D+04	0.1089029D+05
4	0.8762515D+02	0.8805644D+02	0.6940874D+04	0.8449417D+04
5	0.8805644D+02	0.8803714D+02	0.8449417D+04	0.9381748D+04
6	0.8796522D+02	0.8805644D+02	0.7873205D+04	0.8449417D+04
7	0.8805644D+02	0.8802914D+02	0.8449417D+04	0.8805576D+04
8	0.8804336D+02	0.8805644D+02	0.8229324D+04	0.8449417D+04
9	0.8805644D+02	0.8804471D+02	0.8449417D+04	0.8585443D+04
10	0.8807423D+02	0.8805644D+02	0.8365349D+04	0.8449417D+04
11	0.8805451D+02	0.8807423D+02	0.8313392D+04	0.8365349D+04
12	0.8807423D+02	0.8804587D+02	0.8365349D+04	0.8397460D+04
13	0.8803822D+02	0.8807423D+02	0.8345503D+04	0.8365349D+04

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LEFTHAND ABSCISSA OF INTERVAL OF UNCERTAINTY .........  0.4500000D+04
RIGHTHAND ABSCISSA OF INTERVAL OF UNCERTAINTY ........  0.2123000D+05
FRACTIONAL REDUCTION OF INTERVAL OF UNCERTAINTY ......  0.5977286D-02
EXTREME ORDINATE DISCOVERED DURING SEARCH ............  0.8807423D+02
ABSCISSA OF EXTREME ORDINATE .........................  0.8365349D+04
NEW LEFTHAND ABSCISSA OF INTERVAL OF UNCERTAINTY .....  0.8313392D+04
NEW RIGHTHAND ABSCISSA OF INTERVAL OF UNCERTAINTY ....  0.8397460D+04
NUMBER OF FUNCTION EVALUATIONS EXPENDED IN SEARCH ....             13
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LEAR36/TFE731 NOISE PREDICTION AT FAR36 SIDELINE CONDITION

DETAILED FLYOVER NOISE LEVELS,BY COMPONENT, AT EACH 1/2 SECOND INTERVAL ALONG THE PROFILE

TIME SEC	RANGE FEET	ALTITUDE FEET	SLANT DIST,FT	ENGINE-OBSERVER ANGLE,DEG	ELEV ANGLE DEG	COMPONENT	PNL DB	PNLTC DB	OVERALL DB	A-WEIGHTED DB(A)
0.0	4500.0	0.0	4153.5	27.8	-0.1	FANI	50.1	50.9	40.2	40.7
						FAND	24.2	24.2	13.0	14.0
						COMB	44.0	44.1	40.2	35.0
						JET	49.0	49.2	45.2	39.9
						ATUR	30.4	30.6	23.1	20.5
						TOTL	54.6	55.3	47.4	43.9
0.5	4638.4	26.8	4025.1	28.6	0.3	FANI	51.1	51.9	40.8	41.2
						FAND	24.2	24.2	13.0	14.0
						COMB	46.8	47.0	43.5	37.3
						JET	51.8	52.0	48.3	42.0
						ATUR	31.9	32.0	25.6	21.8
						TOTL	56.1	56.8	50.1	45.4
1.0	4776.7	53.6	3897.6	29.4	0.7	FANI	52.4	53.2	42.0	42.2
						FAND	24.2	24.2	13.0	14.0
						COMB	49.3	49.4	46.1	40.2
						JET	54.1	54.3	50.8	44.2
						ATUR	33.7	33.8	27.9	23.6
						TOTL	58.2	59.0	52.5	47.3
1 5	4915.1	80.5	3771.0	30.3	1.2	FANI	53.7	54.5	43.0	43.1
						FAND	24.2	24.2	13.0	14.0
						COMB	50.8	50.9	47.8	41.8
						JET	55.6	55.8	52.3	45.6
						ATUR	35.1	35.2	29.4	24.8
						TOTL	59.6	60.5	54.0	48.6
2.0	5053.5	107.3	3645.5	31.3	1.6	FANI	54.9	55.8	43.8	43.9
						FAND	24.2	24.2	13.0	14.0
						COMB	51.9	52.0	48.9	42.9
						JET	56.7	57.1	53.4	46.6
						ATUR	36.3	36.6	30.5	25.8
						TOTL	60.8	61.5	55.1	49.5
2.5	5191.9	134.1	3521.1	32.3	2.1	FANI	56.3	57.3	44.7	44.8
						FAND	24.2	24.2	13.0	14.0
						COMB	52.8	52.9	49.9	43.8
						JET	57.7	58.2	54.3	47.4
						ATUR	37.4	37.8	31.4	26.8
						TOTL	61.8	62.6	56.0	50.4

3.0	5330.2	160.9	3398.1	33.5	2.6	FANI	57.4	58.5	45.8	46.0
						FAND	24.6	24.9	13.2	14.1
						COMB	53.9	54.0	51.0	44.9
						JET	58.8	59.4	55.3	48.4
						ATUR	38.8	39.3	32.5	27.9
						TOTL	63.0	63.8	57.0	51.5

25.0	11418.7	1341.1	3663.5	154.9	21.4	FANI	31.0	31.7	21.3	21.1
						FAND	46.7	49.2	33.8	34.6
						COMB	65.3	65.5	61.9	55.8
						JET	76.6	77.2	73.3	64.9
						ATUR	40.4	41.1	32.6	30.2
						TOTL	77.2	78.9	73.6	65.4
25.5	11557.1	1367.9	3789.2	155.9	21.1	FANI	30.4	31.0	20.7	20.4
						FAND	45.3	47.8	32.6	33.4
						COMB	64.8	65.0	61.5	55.3
						JET	75.8	76.2	72.7	64.1
						ATUR	39.5	40.1	31.9	29.4
						TOTL	76.5	78.1	73.0	64.6

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NASA GASP NOISE MODULE OUTPUT

LEAR36/TFE731 NOISE PREDICTION AT FAR36 SIDELINE CONDITION

AIRCRAFT NOISE LEVEL PREDICTIONS AT MINIMUM SLANT DISTANCE

TIME SEC	RANGE FEET	ALTITUDE FEET	SLANT DIST,FT	ENGINE-OBSERVER ANGLE,DEG	ELEV ANGLE DEG	COMPONENT	PNL DB	PNLTC DB	OVERALL DB	A-WEIGHTED DB(A)
13.5	8236.1	724.2	1686.9	93.5	25.3	FANI	60.0	61.1	50.4	50.2
						FAND	72.8	76.6	58.5	59.2
						COMB	75.8	76.1	71.7	66.4
						JET	82.5	82.8	75.4	72.2
						ATUR	66.5	66.8	54.8	54.0
						TOTL	84.7	87.4	77.0	73.5

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NASA GASP NOISE MODULE OUTPUT

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LEAR36/TFE731 NOISE PREDICTION AT FAR36 SIDELINE CONDITION

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SUMMARY OUTPUT OF PREDICTED NOISE LEVELS

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COMPONENT	EPNL DB	MAX PNLTC DB	TIME AT MAX PNLTC	ANGLE,DEG MAX PNLTC	DUR CORR	DUR TIME	MAX PNL	TIME AT MAX PNL	ANGLE,DEG MAX PNL	MAX OVERALL DB	TIME AT MAX OVERALL	MAX A-WEIGHTED DB	TIME AT MAX A-WEIGHTED
FANI	66.7	69.0	9.0	56.7	-2.3	11.0	68.3	9.0	56.7	59.7	6.0	60.1	5.5
FAND	73.3	77.2	14.0	98.2	-3.9	9.5	73.6	14.5	102.9	59.8	12.5	60.5	12.5
COMB	75.5	76.8	14.5	102.9	-1.3	15.5	76.5	14.5	102.9	72.6	16.5	66.9	14.0
JET	85.5	86.4	18.0	130.0	-0.9	15.5	86.1	18.0	130.0	81.0	27.5	75.0	16.0
ATUR	66.4	70.7	15.0	107.4	-4.3	8.0	70.4	15.0	107.4	58.9	13.5	58.2	13.5
TOTL	88.1	88.5	15.0	107.4	-0.5	16.0	87.1	16.5	119.8	81.3	27.5	75.6	16.0

FAR36 STAGE 3 NOISE LIMIT FOR INPUT AIRCRAFT IS 94.0 EPN(DB)

****

*****FLYOVER AIRCRAFT NOISE PREDICTION CASE COMPLETED*****

****

*****PSEUDOTONES BELOW 1000 HZ WERE ELIMINATED PER FAA FAR36, B36.5.M , (IPSEUD=1).

*****FLYOVER NOISE LEVELS INCLUDE A DOPPLER SHIFT.

```
*************************************************************************************************************************************
                         LEAR36/TFE731 NOISE PREDICTION AT FAR36 SIDELINE CONDITION
*************************************************************************************************************************************
++++++++++INPUT VARIABLE STATUS AT JOB END+++++
++++++++++INPUT VARIABLE STATUS AT JOB END+++++
                                        INPUT DATA - USER INPUT AND DEFAULT VALUES USED
*************************************************************************************************************************************
CONTROL VARIABLES  *
********************

IFAA= 3   SIDELINE,     IPOUT= 3   FULL     ,                ISTAG= 3            ICAB= 0             ISI= 0  (ENGL UNITS)

************************
ENVIRONMENTAL VARIABLES*
************************

TAMB=536.7          PAMB= 2116.2        RH= 70.             DIST= 100.0         NLOC= 16

ANGLE (ARRAY) =  10.0  20.0  30.0  40.0  50.0  60.0  70.0  80.0  90.0 100.0 110.0 120.0 130.0 140.0 150.0 160.0


************************
ENGINE/AIRCRAFT SYSTEM *
************************

+++++ENGINE VARIABLES+++++
ENGINE TYPE(NTYE)= 1  (FAN )  .......................ENGINE COMPONENT ARRAY(ICOMP) =     1    4    5    6    0    0
                                                                                        FAN  COMB JET  ATUR NONE NONE

+++++AIRFRAME VARIABLES+^+++
AMACH=0.25          VEL= 281.9          ENP= 2.             ANENGI=  0.0        ANENGE=  0.0        XL=  5.5
YL=  2.6            ZL= 16.7            WGMAX= 17000.       LOCENG= 1           IPHASE= 0           IDOP= 1

****************
FLIGHT PROFILE *
****************

IDPRO= 0                                VEL= 281.9          AMACH=0.25          FLTANG=11.0         ANGAFT= 7.2
TCROLL= 4500.       APDIST=    0.0      XALT=1000.

*****A STRAIGHT LINE PROFILE WILL BE COMPUTED FROM A COMBINATION OF THE ABOVE VARIABLES.

****************
FLIGHT OPTIONS *
****************

KGOLD=  1           XLSIDE=  4500.0     XRSIDE= 21230.0     IQS=  1             ICUT=  0            IPSEUD=  1
IDUR= 1             XTOL= 100.          IWING= 0
XFAA= 7516.,21230., 8365.,    0.,       YFAA=    4.,    4.,    4.,    4.,       ZFAA=    0.,    0., 1520.,    0.,

*****THE FLIGHT PROFILE WILL BE TERMINATED WHEN THE OVERALL ENGINE PNLTC IS 10 DB BELOW ITS MAXIMUM VALUE (IDUR=1).
```

ORIGINAL PAGE IS
OF POOR QUALITY

****

LEAP36/TFE731 NOISE PREDICTION AT FAR36 SIDELINE CONDITION

****

++++++++++INPUT VARIABLE STATUS AT JOB END+++++

++++++++++INPUT VARIABLE STATUS AT JOB END+++++

****

ENGINE COMPONENT VARIABLES AT INPUT*

****

+++++FAN +++++

IGV= 0	IFD= 0	NH= 8	NSTG= 1	NBF= 30	NVAN=109
RSS=200.00	WAFAN=108.50	RPM= 11091.	DELT= 79.40	FPR= 0.0	FANDIA= 2.3190
FANHUB= 1.1250	TIPMD=1.4800	TIPM=1.2870	FANEFF=0.0	NBF2= 0	NVAN2= 0
FAND2= 0.0	TIPMD2=0.0	TIPM2=0.0	RSS2=100.00	PRAT= 0.0	TRAT=0.0
FANEF2=0.0	IBUZ= 0	ITONE= 0	AMACH=0.2482	CAEF= 40.0	

+++++COMB+++++

WACOMB= 29.50	T3=1268.5	T4=2280.5	P3= 28653.0	CAEC= 20.0
AMACH=0.248				

+++++JET +++++

VJ=1473.0	TJ=1425.0	DJ= 0.9594	HJ=0.47970	GAMJ=1.3330	VJ2= 915.0
TJ2= 620.0	DJ2= 1.6292	HJ2=0.33490	GAMJ2=1.4010	EL2= 0.78	ALFAJ= 7.20
PHIJ=56.31	V0= 281.9	INVOPT= 0			

+++++ATUR+++++

RPMT= 19951.0	DT= 1.282	DH= 0.816	ACNZ= 0.824	NBT= 80	DTOT=0.45000
PRTS= 0.0	GAMAT=1.33300	CAET= 40.0	AMACH=0.248		

***** A DOPPLER FREQUENCY SHIFT WILL BE APPLIED TO ALL SOURCE STATIC SPECTRA AS A FUNCTION OF FLIGHT MACH NO. AND ANGLE FROM INLET.

APPENDIX A

Sample Test Case 4

Level Flyover Condition for a Turboprop-Powered Executive Aircraft

```
                                   NASA LEWIS RESEARCH CENTER                        76.
                                  NASA GASP NOISE MODULE OUTPUT
*****************************************************************************************************************
                      MITSUBISHI MU2J/TPE331 NOISE PREDICTION AT FAR36 1000 FT LEVEL FLYOVER
*****************************************************************************************************************
                                   INPUT DATA - USER INPUT AND DEFAULT VALUES USED
*****************************************************************************************************************
CONTROL VARIABLES  *
********************

IFAA= 4   FLYOVER ,     IPOUT= 3   FULL    ,              ISTAG= 3           ICAB= 1            ISI= 0  (   UNITS

************************
ENVIRONMENTAL VARIABLES*
************************

TAMB=518.7          PAMB= 2116.2        RH= 70.             DIST= 100.0         NLOC= 16

ANGLE (ARRAY) =  10.0  20.0  30.0  40.0  50.0  60.0  70.0  80.0  90.0 100.0 110.0 120.0 130.0 140   150.0 160.0


************************
ENGINE/AIRCRAFT SYSTEM *
************************

+++++ENGINE VARIABLES+++++
ENGINE TYPE(NTYE)= 3  (PROP)  .......................ENGINE COMPONENT ARRAY(ICOMP) =    3    4    5    6    8    0
                                                                                      CENF COMB JET  ATUR PROP NONE

+++++AIRFRAME VARIABLES+++++
AMACH=0 34          VEL= 380.0          ENP= 2.             ANENGI=  0.0        ANENGE=  0.0        XL=  1.0
Y                   ZL=  1.0            WGMAX= 10800.       LOCENG= 2           IPHASE= 0           IDOP= 1

****************
FLIGHT PROFILE *
****************

IDPPO= 0                                VEL= 380.0          AMACH=0.34          FLTANG= 0.0         ANGAFT= 0.0
TOROLL=    0        APDIST= 5671.4      XALT=1000.

*****A STRAIGHT LINE PROFILE WILL BE COMPUTED FROM A COMBINATION OF THE ABOVE VARIABLES.

****************
FLIGHT OPTIONS *
****************

KGOLD=  0           XLSIDE=     0.0     XRSIDE=     0.0     IQS=  1             ICUT=  0            IPSEUD=  0
IDUR= 0             XTOL= 100.          IWING= 0
XFAA= 7516.,21325.,21325.,    0.,       YFAA=    4.,     4.,     4.,     4.,      ZFAA=    0.,     0., 1476.,     0.,

D50= 2400.0         RC=1880.0           VY= 13065.0
```

```
*****************************************************************************************************************
                    MITSUBISHI MU2J/TPE331 NOISE PREDICTION AT FAR36 1000 FT LEVEL FLYOVER
*****************************************************************************************************************
***********************************
ENGINE COMPONENT VARIABLES AT INPUT*
***********************************

+++++CENF+++++
DTLE= 0.555         DHLE= 0.208        T1= 518.7          P1=  2116.0        RPMC= 41730.0      CMASS=   7.78
DELTC= 0.6100       NBC= 17            CMASSD=    7.76    RPMCD= 41730.0     CAECN= 40.0        AMACH=0.3403

+++++COMB+++++
WACOMB=   7.78      T3=1124.7          T4=2166.6          P3= 17675.0        CAEC= 20.0
AMACH=0.340

+++++JET +++++
VJ= 621.0           TJ=1371.9          DJ= 0.8360         HJ=0.41800         GAMJ=1.3330        VJ2=   0.0
TJ2=   0.0          DJ2= 0.0           HJ2=0.0            GAMJ2=1.4010       EL2=  0.0          ALFAJ= 0.0
PHIJ= 0.0           V0= 380.0          INVOPT= 0

+++++ATUR+++++
RPMT= 41730.0       DT= 0.750          DH= 0.477          ACNZ= 0.0          NBY= 44            DTOT=0.28800
PRTS= 0.0           GAMAT=1.33300      CAET= 40.0         AMACH=0.340

+++++PROP+++++
DIAP=  8.17         NBP=  4            SHP= 665.00        RPMP= 1591.0       ALTJT=  -1.0       CAEP= 40.0
VEL= 380.0          AMACH=0.340        BLTH=0.0400        BLCH=0.6000        BLAK= 5.0000       BLAREA=  6.0008

***** A DOPPLER FREQUENCY SHIFT WILL BE APPLIED TO ALL SOURCE STATIC SPECTRA AS A FUNCTION OF FLIGHT MACH NO. AND ANGLE FROM INLET.
```

****

MITSUBISHI MU2J/TPE331 NOISE PREDICTION AT FAR36 1000 FT LEVEL FLYOVER

****

FLIGHT PROFILE GENERATED FOR FLYOVER PREDICTIONS

****

VEL= 380.0 AMACH=0.340 TOROLL= 0. APDIST= 5671. XALT=1000. (FOR LEVEL FLYOVER)

TIME SECONDS	IPRO	RANGE FEET	ALTITUDE FEET	AIRCRAFT ANGLE OF ATTACK,DEG	FLIGHT ANGLE DEG
0.0	1	5671.4	1000.0	0.0	0.0
0.5	2	5481.4	1000.0	0.0	0.0
1.0	3	5291.4	1000.0	0.0	0.0
1.5	4	5101.4	1000.0	0.0	0.0
2.0	5	4911.4	1000.0	0.0	0.0
2.5	6	4721.4	1000.0	0.0	0.0
3.0	7	4531.4	1000.0	0 0	0.0
3.5	8	4341.4	1000.0	0.0	0.0
4.0	9	4151.4	1000.0	0.0	0.0
4.5	10	3961.4	1000.0	0.0	0.0
5.0	11	3771.4	1000.0	0.0	0.0
5.5	12	3581.4	1000.0	0.0	0.0
6.0	13	3391.4	1000.0	0 0	0.0
6.5	14	3201.4	1000.0	0 0	0.0
7.0	15	3011.4	1000.0	0.0	0.0
7.5	16	2821.4	1000.0	0.0	0.0
8.0	17	2631.4	1000.0	0.0	0.0
8.5	18	2441.4	1000.0	0.0	0.0
9.0	19	2251.4	1000.0	0.0	0.0
9.5	20	2061.4	1000.0	0.0	0.0
10.0	21	1871.4	1000.0	0.0	0.0
10.5	22	1681.4	1000.0	0.0	0.0
11.0	23	1491.4	1000.0	0.0	0.0
11.5	24	1301.4	1000.0	0.0	0 0
12.0	25	1111.4	1000.0	0.0	0.0
12.5	26	921.4	1000.0	0.0	0.0
13.0	27	731.4	1000.0	0.0	0.0
13.5	28	541.4	1000.0	0.0	0.0
14.0	29	351.4	1000.0	0.0	0.0
14.5	30	161.4	1000.0	0.0	0.0
15.0	31	-28.6	1000.0	0.0	0.0
15.5	32	-218.6	1000.0	0.0	0.0
16.0	33	-408.6	1000.0	0.0	0.0
16.5	34	-598.6	1000.0	0.0	0.0
17.0	35	-788.6	1000.0	0.0	0.0
17.5	36	-978.6	1000.0	0.0	0.0

18.0	37	-1168.6	1000.0	0.0	0.0
18.5	38	-1358.6	1000.0	0.0	0.0
19.0	39	-1548.6	1000.0	0.0	0.0
19.5	40	-1738.6	1000.0	0.0	0.0
20.0	41	-1928.6	1000.0	0.0	0.0
20.5	42	-2118.6	1000.0	0.0	0.0
21.0	43	-2308.6	1000.0	0.0	0.0
21.5	44	-2498.6	1000.0	0.0	0.0
22.0	45	-2688.6	1000.0	0.0	0.0
22.5	46	-2878.6	1000.0	0.0	0.0
23.0	47	-3068.6	1000.0	0.0	0.0
23.5	48	-3258.6	1000.0	0.0	0.0
24.0	49	-3448.6	1000.0	0.0	0.0
24.5	50	-3638.6	1000.0	0.0	0.0
25.0	51	-3828.6	1000.0	0.0	0.0
25.5	52	-4018.6	1000.0	0.0	0.0
26.0	53	-4208.6	1000.0	0.0	0.0
26.5	54	-4398.6	1000.0	0.0	0.0
27.0	55	-4588.6	1000.0	0.0	0.0
27.5	56	-4778.6	1000.0	0.0	0.0
28.0	57	-4968.6	1000.0	0.0	0.0
28.5	58	-5158.6	1000.0	0.0	0.0
29.0	59	-5348.6	1000.0	0.0	0.0
29.5	60	-5538.6	1000.0	0.0	0.0

NASA LEWIS RESEARCH CENTER PAGE 10
NASA GASP NOISE MODULE OUTPUT

MITSUBISHI MU2J/TPE331 NOISE PREDICTION AT FAR36 1000 FT LEVEL FLYOVER

DETAILED FLYOVER NOISE LEVELS,BY COMPONENT, AT EACH 1/2 SECOND INTERVAL ALONG THE PROFILE

TIME SEC	RANGE FEET	ALTITUDE FEET	SLANT DIST,FT	ENGINE-OBSERVER ANGLE,DEG	ELEV ANGLE DEG	COMPONENT	PNL DB	PNLTC DB	OVERALL DB	A-WEIGHTED DB(A)
0.0	5671.4	1000.0	5758.2	10.0	10.0	CENT	58.3	58.8	52.9	49.3
						COMB	45.2	46.0	40.4	37.0
						JET	31.0	31.5	27.1	20.4
						ATUR	27.8	28.3	20.8	17.8
						PROP	59.2	64.7	60.3	49.4
						TOTL	63.4	66.1	61.0	52.5
0.5	5481.4	1000.0	5571.1	10.3	10.3	CENT	59.0	59.5	53.3	50.0
						COMB	45.9	46.7	41.0	37.7
						JET	31.5	32.0	27.4	21.0
						ATUR	28.4	28.9	21.3	18.4
						PROP	59.9	65.6	60.8	50.2
						TOTL	64.1	66.8	61.6	53.2
1.0	5291.4	1000.0	5384.3	10.7	10.7	CENT	59.7	60.3	53.8	50.7
						COMB	46.6	47.4	41.6	38.5
						JET	32.0	32.5	27.8	21.5
						ATUR	29.0	29.5	21.8	19.0
						PROP	60.7	66.5	61.4	51.0
						TOTL	64.8	67.5	62.1	54.0
1.5	5101.4	1000.0	5197.7	11.0	11.0	CENT	60.5	61.2	54.4	51.4
						COMB	47.4	48.1	42.3	39.3
						JET	32.5	33.1	28.1	22.1
						ATUR	29.5	30.1	22.3	19.6
						PROP	61.5	67.4	62.0	51.9
						TOTL	65.5	68.3	62.7	54.8
2.0	4911.4	1000.0	5011.4	11.5	11.5	CENT	61.2	62.0	54.9	52.1
						COMB	48.1	48.9	43.0	40.1
						JET	33.0	33.6	28.5	22.7
						ATUR	30.2	30.7	22.9	20.3
						PROP	62.3	68.4	62.6	52.9
						TOTL	66.2	69.1	63.3	55.6

NASA LEWIS RESEARCH CENTER PAGE 4
NASA GASP NOISE MODULE OUTPUT

MITSUBISHI MU2J/TPE331 NOISE PREDICTION AT FAR36 1000 FT LEVEL FLYOVER

NOISE SOURCE= CENT ** DISTANCE = 100.0 ** ONE-THIRD OCTAVE BAND AND OVERALL ENGINE COMPONENT SOURCE NOISE LEVEL SUMMARY

1/3 OCTAVE BAND CENTER FREQUENCY	SOUND PRESSURE LEVEL,DB — MIKE LOCATIONS IN DEGREES 10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.	SOUND POWER LEVEL,DB
20.0	65.3	65.2	65.5	64.8	62.1	58.2	51.4	48.0	43.7	39.9	36.2	32.4	28.9	25.5	22.2	18.9	108.6
25.0	66.1	66.0	66.3	65.7	62.9	59.1	52.2	48.8	44.5	40.8	37.1	33.6	30.0	26.6	23.3	20.0	109.5
31.5	67.0	66.9	67.2	66.5	63.7	60.0	53.2	49.9	45.6	41.9	38.2	34.6	31.1	27.7	24.3	21.1	110.3
40.0	67.8	67.8	68.1	67.5	64.8	61.1	54.3	51.0	46.7	42.9	39.2	35.5	32.0	28.5	25.2	21.9	111.3
50.0	69.0	68.9	69.2	68.6	65.9	62.1	55.2	51.8	47.5	43.8	40.1	36.5	33.0	29.6	26.3	23.0	112.4
63.0	70.0	69.9	70.2	69.5	66.7	62.9	56.1	52.9	48.6	44.9	41.2	37.6	34.1	30.7	27.3	24.0	113.3
80.0	70.8	70.7	71.1	70.5	67.8	64.1	57.3	54.0	49.7	45.9	42.2	38.5	34.9	31.5	28.1	24.9	114.3
100.0	71.9	71.9	72.2	71.6	68.9	65.1	58.2	54.8	50.5	46.8	43.1	39.5	36.0	32.6	29.2	26.0	115.4
125.0	73.0	72.9	73.2	72.5	69.7	65.9	59.1	55.8	51.6	47.8	44.2	40.6	37.1	33.6	30.3	27.0	116.3
160.0	73.8	73.7	74.1	73.5	70.8	67.0	60.2	57.0	52.7	48.9	45.2	41.5	37.9	34.5	31.1	27.9	117.3
200.0	74.9	74.8	75.1	74.6	71.9	68.1	61.2	57.8	53.5	49.7	46.0	42.4	38.9	35.5	32.1	28.9	118.4
250.0	75.9	75.8	76.1	75.5	72.7	68.9	62.1	58.8	54.5	50.8	47.1	43.5	40.0	36.6	33.2	30.0	119.3
315.0	76.8	76.7	77.0	76.4	73.7	69.9	63.1	59.9	55.6	51.9	48.2	44.6	41.1	37.6	34.3	31.0	120.3
400.0	77.8	77.7	78.1	77.5	74.8	71.0	64.2	60.9	56.6	52.9	49.1	45.4	41.9	38.5	35.1	31.9	121.3
500.0	78.9	78.8	79.1	78.5	75.8	72.0	65.2	61.8	57.5	53.7	50.0	46.5	43.0	39.5	36.2	33.0	122.4
630.0	79.9	79.8	80.1	79.4	76.7	72.9	66.1	62.8	58.5	54.8	51.1	47.5	44.0	40.6	37.2	34.0	123.3
800.0	80.7	80.6	81.0	80.4	77.7	74.0	67.2	63.9	59.6	55.8	52.1	48.4	44.9	41.4	38.0	34.8	124.3
1000.0	81.8	81.7	82.1	81.5	78.8	74.9	68.1	64.7	60.4	56.6	52.9	49.3	45.8	42.3	38.9	35.6	125.4
1250.0	82.8	82.7	83.0	82.3	79.6	75.8	68.9	65.6	61.3	57.4	53.6	49.9	46.3	42.8	39.4	36.1	126.3
1600.0	83.6	83.5	83.8	83.2	80.4	76.6	69.6	66.2	61.8	57.9	54.1	50.3	46.7	43.2	39.7	36.5	127.2
2000.0	84.4	84.2	84.5	83.8	80.9	77.0	70.0	66.5	62.1	58.2	54.4	50.7	47.1	43.6	40.2	36.9	127.9
2500.0	84.8	84.6	84.9	84.1	81.3	77.3	70.4	66.9	62.5	58.7	54.9	51.2	47.6	44.1	40.8	37.5	128.4
3150.0	85.1	84.9	85.2	84.4	81.6	77.7	70.8	67.4	63.0	59.2	55.5	51.9	48.3	44.9	41.5	38.2	128.8
4000.0	85.4	85.2	85.5	84.8	82.0	78.2	71.3	68.0	63.7	59.9	56.1	52.4	48.8	45.5	42.2	39.0	129.4
5000.0	85.9	85.8	86.1	85.5	82.8	78.9	72.1	68.6	64.3	60.7	57.2	53.8	50.5	47.3	44.1	41.0	130.2
6300.0	86.4	86.3	86.6	85.8	83.1	79.5	72.9	69.9	65.9	62.5	59.2	55.6	52.6	49.6	46.7	43.7	131.0
8000.0	86.8	86.8	87.3	86.9	84.4	81.0	74.7	71.5	68.0	65.2	62.5	60.2	57.4	54.5	51.6	48.6	132.6
10000.0	88.1	88.2	88.8	88.2	86.2	83.3	77.6	75.9	72.6	69.8	66.9	65.2	61.6	57.9	54.1	50.6	135.1
12500.0	90.1	90.4	91.4	92.1	90.4	87.6	81.7	80.4	75.8	71.0	65.6	57.0	51.8	47.1	43.0	39.3	139.8
16000.0	93.8	94.0	94.9	96.2	93.3	88.7	80.0	71.0	64.4	59.2	54.7	52.1	48.3	44.6	41.0	37.6	144.6
20000.0	95.5	95.7	96.6	87.1	81.8	75.3	65.6	65.8	61.1	56.9	52.8	48.8	44.9	41.2	37.7	34.3	144.9

++++++++++																	
OA(20-20K)																	
LINEAR	100.5	100.7	101.4	100.1	97.5	93.6	86.7	83.8	79.5	75.6	71.7	68.4	64.9	61.4	57.9	54.7	149.1
A-SCALE	97.4	97.4	97.8	97.3	94.7	91.0	84.3	81.4	77.3	73.6	69.9	66.8	63.3	59.9	56.6	53.3	144.0
++++++++++																	
OA(50-10K)																	
LINEAR	96.4	96.3	[illegible]	96.0	93.4	89.9	83.4	80.5	76.7	73.5	70.3	67.9	64.5	61.1	57.7	54.4	141.1
A-SCALE	96.2	96.1	96.4	95.7	93.1	89.4	82.8	79.8	75.9	72.5	[illegible]	66.6	63.2	59.8	56.5	53.2	140.6
++++++++++																	
PERCEIVED NOISE LEVL																	
PNL	109.2	109.1	109.4	108.8	106.0	102.2	95.5	92.2	88.3	85.0	81.7	79.0	75.5	72.0	68.7	65.6	
PNLTC	109.3	109.2	109.5	108.8	106.1	102.3	95.5	92.2	88.4	85.0	61.7	79.1	75.6	72.1	68.9	65.8	

*****STATIC LEVELS AT AMBIENT CORRECTED TO FAA STD DAY CONDITIONS (77 DEG F, 70 PCT RH) FOR FLYOVER PREDICTIONS ONLY

NASA LEWIS RESEARCH CENTER PAGE 5
NASA GASP NOISE MODULE OUTPUT

MITSUBISHI MU2J/TPE331 NOISE PREDICTION AT FAR36 1000 FT LEVEL FLYOVER

NOISE SOURCE= COMB ** DISTANCE = 100.0 ** ONE-THIRD OCTAVE BAND AND OVERALL ENGINE COMPONENT SOURCE NOISE LEVEL SUMMARY

1/3 OCTAVE BAND CENTER FREQUENCY	SOUND PRESSURE LEVEL,DB MIKE LOCATIONS IN DEGREES 10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.	SOUND POWER LEVEL,DB
20.0	23.2	25.0	26.7	28.5	30.6	32.0	33.4	34.9	36.9	38.7	39.9	40.6	40.9	40.2	37.4	34.4	87.6
25.0	27.2	29.0	30.7	32.6	34.7	36.1	37.4	38.9	40.9	42.8	44.0	44.8	45.1	44.4	41.6	38.6	91.8
31.5	31.3	33.1	34.8	36.6	38.7	40.1	41.5	43.0	45.1	47.0	48.2	49.1	49.4	48.7	45.9	42.8	96.0
40.0	35.3	37.1	38.9	40.7	42.9	44.3	45.8	47.3	49.4	51.2	52.4	53.3	53.5	52.8	50.0	46.9	100.2
50.0	39.5	41.3	43.1	45.0	47.1	48.6	50.0	51.5	53.5	55.3	56.5	57.4	57.6	56.9	54.0	50.9	104.3
63.0	43.8	45.6	47.3	49.2	51.3	52.7	54.1	55.6	57.6	59.2	60.3	60.9	61.0	60.2	57.2	54.2	108.0
80.0	47.9	49.7	51.4	53.3	55.3	56.7	57.8	59.0	60.9	62.5	63.5	64.2	64.3	63.5	60.5	57.4	111.3
100.0	51.8	53.6	55.2	56.8	58.7	59.9	61.1	62.4	64.2	65.8	66.7	67.4	67.5	66.6	63.6	60.5	114.6
125.0	55.1	56.8	58.4	60.1	62.0	63.2	64.3	65.6	67.3	68.8	69.6	70.1	70.1	69.2	66.1	63.0	117.4
160.0	58.3	60.1	61.6	63.3	65.1	66.2	67.2	68.2	69.9	71.3	72.1	72.6	72.6	71.7	68.6	65.4	120.0
200.0	61.4	63.0	64.5	66.0	67.7	68.8	69.7	70.7	72.3	73.7	74.5	75.0	74.9	73.9	70.7	67.5	122.4
250.0	63.9	65.5	67.0	68.5	70.2	71.2	72.1	73.1	74.6	75.8	76.3	76.4	76.2	75.1	71.9	68.6	124.2
315.0	66.3	67.9	69.4	70.9	72.5	73.3	73.9	74.5	75.8	76.9	77.3	77.8	77.4	76.1	72.8	69.4	125.6
400.0	68.3	69.9	71.2	72.3	73.7	74.4	74.9	75.8	76.8	77.5	77.5	76.9	76.2	74.7	71.2	67.8	125.9
500.0	69.4	71.0	72.2	73.7	74.9	75.2	75.2	74.8	75.4	75.9	75.8	75.5	74.8	73.3	69.8	66.3	125.1
630.0	70.2	71.5	72.4	72.8	73.6	73.6	73.4	73.4	74.0	74.4	74.2	74.0	73.2	71.6	68.0	64.4	123.7
800.0	68.5	69.8	70.6	71.3	72.1	72.1	71.9	71.8	72.3	72.5	72.2	71.4	70.5	68.8	65.2	61.6	121.8
1000.0	67.0	68.2	69.1	69.8	70.4	70.2	69.8	69.3	69.5	69.6	69.2	68.7	67.8	66.0	62.4	58.8	119.5
1250.0	65.1	66.3	67.0	67.3	67.7	67.4	66.9	66.5	66.7	66.8	66.4	65.8	64.8	63.0	59.3	55.6	116.8
1600.0	62.2	63.4	64.0	64.5	64.9	64.6	64.0	63.5	63.7	63.6	63.0	62.1	60.9	59.1	55.3	51.6	113.7
2000.0	59.4	60.5	61.1	61.5	61.9	61.4	60.6	59.8	59.7	59.6	59.0	58.2	57.1	55.3	51.5	47.9	110.3
2500.0	56.2	57.2	57.7	57.8	58.0	57.3	56.6	55.9	55.9	55.8	55.3	54.6	53.6	51.8	48.0	44.4	106.6
3150.0	52.1	53.1	53.6	53.8	54.1	53.5	52.8	52.3	52.4	52.3	51.7	51.0	50.0	48.1	44.4	40.7	103.0
4000.0	48.2	49.2	49.8	50.1	50.4	49.9	49.2	48.6	48.6	48.5	47.8	46.9	45.8	43.9	40.1	36.4	99.5
5000.0	44.7	45.7	46.3	46.6	46.8	46.2	45.4	44.6	44.5	44.3	43.5	42.7	41.5	39.6	35.7	32.0	95.7
6300.0	40.7	41.7	42.2	42.3	42.4	41.7	40.9	40.1	39.9	39.7	38.9	38.1	36.8	34.9	31.0	27.3	91.7
8000.0	36.0	37.0	37.5	37.6	37.7	37.0	36.1	35.2	35.0	34.7	33.9	32.8	31.5	29.5	25.6	21.8	87.4
10000.0	31.0	32.0	32.4	32.5	32.5	31.7	30.7	29.7	29.4	29.0	28.1	27.1	25.8	23.8	19.9	16.1	82.9
12500.0	25.4	26.3	26.7	26.6	26.5	25.6	24.6	23.7	23.3	22.8	21.9	20.7	19.3	17.2	13.3	9.5	78.0
16000.0	18.7	19.6	19.9	20.0	19.9	19.0	17.8	16.6	16.2	15.6	14.6	13.5	12.0	9.9	6.0	2.1	73.0
20000.0	11.3	12.2	12.6	12.2	12.0	11.0	9.8	8.6	8.1	7.5	6.5	5.4	4.0	1.9	0.0	0.0	67.7

++++++++++																	
OA(20-20K)																	
LINEAR	77.3	78.7	79.8	80.8	81.9	82.3	82.6	82.9	83.9	84.7	85.0	85.0	84.5	83.2	79.9	76.5	133.6
A-SCALE	75.2	76.5	77.5	78.3	79.1	79.2	79.2	79.2	79.8	80.3	80.3	80.0	79.3	77.8	74.3	70.8	129.5
++++++++++																	
OA(50-10K)																	
LINEAR	77.3	78.7	79.8	80.8	81.9	82.3	82.6	82.9	83.9	84.7	85.0	84.9	84.5	83.2	79.9	76.5	133.6
A-SCALE	75.2	76.5	77.5	78.3	79.1	79.2	79.2	79.2	79.8	80.3	80.3	80.0	79.3	77.8	74.3	70.8	129.5
++++++++++																	
PERCEIVED NOISE LEVL																	
PNL	84.1	85.4	86.4	87.4	88.4	88.6	88.6	88.9	89.8	90.4	90.4	90.0	89.4	87.9	84.4	80.8	
PNLTC	84.4	85.7	86.6	87.6	88.7	88.9	88.8	89.0	89.9	90.5	90.5	90.2	89.5	88.0	84.5	81.0	

*****STATIC LEVELS AT AMBIENT CORRECTED TO FAA STD DAY CONDITIONS (77 DEG F, 70 PCT RH) FOR FLYOVER PREDICTIONS ONLY

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OF POOR QUALITY

MITSUBISHI MU2J/TPE331 NOISE PREDICTION AT FAR36 1000 FT LEVEL FLYOVER

NOISE SOURCE= JET ** DISTANCE = 100.0 ** ONE-THIRD OCTAVE BAND AND OVERALL ENGINE COMPONENT SOURCE NOISE LEVEL SUMMARY

1/3 OCTAVE BAND CENTER FREQUENCY	SOUND PRESSURE LEVEL,DB MIKE LOCATIONS IN DEGREES 10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.	SOUND POWER LEVEL,DB
20.0	36.3	36.4	36.5	36.8	37.0	37.3	37.6	37.9	38.3	38.6	39.0	39.3	40.6	44.6	48.3	47.5	91.5
25.0	38.4	38.5	38.7	38.9	39.1	39.4	39.7	40.1	40.4	40.8	41.1	41.5	43.0	47.5	50.6	49.2	93.8
31.5	40.6	40.7	40.9	41.1	41.4	41.7	42.0	42.3	42.7	43.1	43.4	43.8	45.3	49.6	52.1	50.9	95.8
40.0	43.0	43.1	43.3	43.4	43.7	43.9	44.2	44.5	44.8	45.2	45.4	45.8	47.3	51.1	53.2	52.8	97.5
50 0	45.0	45.1	45.2	45.3	45.5	45.7	45.9	46.2	46.4	46.7	46.9	47.3	48.9	52.5	53.9	54.0	99.0
63.0	46.6	46.7	46.8	46.9	47.0	47.1	47.3	47.5	47.7	47.9	48.1	48.6	50.5	53.8	54.7	54.8	100.1
80.0	47.9	48.0	48.0	48.1	48.2	48.3	48.4	48.6	48.8	48.9	49.1	49.8	51.8	54.2	54.8	54.7	100.9
100.0	48.9	48.9	49.0	49.0	49.1	49.2	49.3	49.5	49.6	49.8	50.0	50.7	52.6	54.0	54.3	53.6	101.3
125.0	49.8	49.8	49.8	49.9	49.9	50.0	50.1	50.2	50.3	50.5	50.6	51.4	53.0	53.7	53.5	52.0	101.6
160.0	50.6	50.6	50.6	50.6	50.6	50.7	50.7	50.8	50.9	51.0	51.1	51.7	52.8	52.7	52.1	50.0	101.7
200.0	51.1	51.1	51.1	51.0	51.0	51.1	51.1	51.1	51.2	51.3	51.4	51.8	52.3	51.5	50.6	48.3	101.7
250.0	51.4	51.4	51.4	51.3	51.3	51.3	51.3	51.4	51.4	51.5	51.6	51.8	51.7	50.2	49.0	46.5	101.7
315.0	51.6	51.6	51.5	51.5	51.4	51.4	51.4	51.4	51.4	51.4	51.5	51.5	50.9	48.8	47.4	44.7	101.5
400.0	51.5	51.5	51.4	51.4	51.3	51.3	51.3	51.3	51.3	51.3	51.3	51.2	50.0	47.4	45.7	42.8	101.3
500.0	51.4	51.4	51.3	51.2	51.1	51.1	51.0	50.9	50.9	50.9	50.9	50.6	49.0	46.1	44.1	41.1	100.9
630.0	51.1	51.0	50.9	50.8	50.7	50.6	50.5	50.4	50.3	50.3	50.3	49.8	47.9	44.7	42.5	39.3	100.3
800.0	50.5	50.4	50.3	50.2	50.0	49.9	49.8	49.7	49.6	49.6	49.6	49.0	46.7	43.3	40.8	37.4	99.6
1000.0	49.8	49.7	49.6	49.5	49.4	49.2	49.1	49.0	49.0	48.9	48.9	48.2	45.6	42.0	39.2	35.6	98.9
1250.0	49.1	49.1	48.9	48.8	48.6	48.5	48.3	48.2	48.1	48.0	48.0	47.2	44.5	40.7	37.6	33.9	98.1
1600.0	48.2	48.1	48.0	47.8	47.6	47.5	47.3	47.2	47.1	47.0	46.9	46.1	43.2	39.2	35.9	31.9	97.1
2000.0	47.2	47.1	47.0	46.8	46.6	46.4	46.3	46.1	46.0	45.9	45.8	45.0	42.1	37.9	34.3	30.2	96.2
2500.0	46.2	46.1	45.9	45.8	45.6	45.4	45.2	45.1	44.9	44.8	44.8	43.9	40.9	36.6	32.7	28.4	95.2
3150 0	45.1	45.0	44.8	44.7	44.5	44.3	44.1	44.0	43.8	43.7	43.7	42.7	39.6	35.2	31.1	26.6	94.2
4000.0	43.9	43.8	43.7	43.5	43.3	43.1	42.9	42.7	42.6	42.5	42.4	41.5	38.4	33.8	29.4	24.7	93.2
5000.0	42.8	42.7	42.5	42.3	42.1	41.9	41.7	41.6	41.4	41.3	41.3	40.4	37.2	32.5	27.8	23.0	92.2
6300.0	41.6	41.5	41.3	41.1	41.0	40.8	40.6	40.4	40.3	40.2	40.1	39.2	36.0	31.1	26.2	21.2	91.4
8000.0	40.4	40.3	40.2	40.0	39.8	39.6	39.4	39.2	39.1	39.0	38.9	38.0	34.7	29.7	24.5	19.3	90.8
10000.0	39.3	39.2	39.0	38.8	38.6	38.4	38.2	38.1	37.9	37.8	37.7	36.8	33.5	28.4	22.9	17.5	90.5
12500.0	38.1	38.0	37.8	37.7	37.5	37.3	37.1	36.9	36.8	36.7	36.6	35.6	32.3	27.1	21.3	15.8	90.5
16000.0	36.8	36.7	36.6	36.4	36.2	36.0	35.8	35.6	35.5	35.4	35.3	34.3	31.0	25.6	19.6	13.8	91.0
20000.0	35.7	35.6	35.4	35.2	35.0	34.8	34.6	34.4	34.3	34.2	34.1	33.2	29.8	24.3	18.0	12.1	92.4

++++++++++																	
OA(20-20K)																	
LINEAR	62.7	62.7	62.6	62.6	62.5	62.5	62.5	62.5	62.5	62.6	62.7	62.7	62.8	63.4	63.8	63.0	113.4
A-SCALE	59.5	59.4	59.3	59.2	59.0	58.9	58.8	58.7	58.6	58.6	58.5	58.0	56.0	53.1	51.1	48.2	108.8
++++++++++																	
OA(50-10K)																	
LINEAR	62.6	62.5	62.5	62.4	62.4	62.3	62.3	62.3	62.3	62.4	62.5	62.5	62.5	62.7	62.7	61 8	113.0
A-SCALE	59.4	59.4	59.3	59.1	59.0	58.9	58.7	58.7	58.6	58.5	58.5	58.0	56.0	53.1	51.0	48.2	108.8
++++++++++																	
PERCEIVED NOISE LEVL																	
PNL	71.7	71.7	71.6	71.4	71.3	71.1	71.0	70.9	70.8	70.8	70.8	70.2	68.1	65.2	63.1	60.1	
PNLTC	71.8	71 7	71.6	71.5	71.3	71.2	71.0	70.9	70.9	70.8	70.8	70.2	68.1	65.3	63.1	60.1	

*****STATIC LEVELS AT AMBIENT CORRECTED TO FAA STD DAY CONDITIONS (77 DEG F, 70 PCT RH) FOR FLYOVER PREDICTIONS ONLY

NASA LEWIS RESEARCH CENTER PAGE 7
NASA GASP NOISE MODULE OUTPUT

MITSUBISHI MU2J/TPE331 NOISE PREDICTION AT FAR36 1000 FT LEVEL FLYOVER

NOISE SOURCE= ATUR ** DISTANCE = 100.0 ** ONE-THIRD OCTAVE BAND AND OVERALL ENGINE COMPONENT SOURCE NOISE LEVEL SUMMARY

1/3 OCTAVE BAND CENTER FREQUENCY	SOUND PRESSURE LEVEL,DB MIKE LOCATIONS IN DEGREES																SOUND POWER LEVEL,DB
	10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.	
20.0	32.6	33.3	33.8	34.2	34.5	34.7	34.8	35.0	35.2	38.9	40.7	39.5	35.6	30.7	26.3	24.1	86.7
25.0	33.6	34.3	34.8	35.2	35.4	35.6	35.8	36.0	36.2	39.9	41.7	40.5	36.6	31.7	27.3	25.1	87.7
31.5	34.6	35.3	35.8	36.1	36.4	36.6	36.8	37.0	37.2	40.9	42.7	41.5	37.6	32.7	28.4	26.1	88.7
40.0	35.5	36.2	36.8	37.1	37.4	37.6	37.8	38.0	38.2	42.0	43.8	42.5	38.6	33.7	29.4	27.1	89.7
50.0	36.5	37.2	37.8	38.2	38.4	38.6	38.8	39.0	39.2	42.9	44.7	43.5	39.6	34.7	30.4	28.1	90.7
63.0	37.6	38.3	38.8	39.1	39.4	39.6	39.8	40.0	40.2	43.9	45.8	44.6	40.7	35.7	31.4	29.1	91.7
80.0	38.5	39.2	39.8	40.1	40.4	40.6	40.8	41.0	41.2	45.0	46.8	45.6	41.6	36.7	32.4	30.1	92.7
100.0	39.5	40.2	40.8	41.2	41.5	41.7	41.8	42.0	42.2	45.9	47.7	46.5	42.6	37.7	33.3	31.1	93.7
125.0	40.6	41.3	41.8	42.2	42.4	42.6	42.8	43.0	43.2	46.9	48.8	47.6	43.7	38.8	34.4	32.2	94.7
160.0	41.5	42.2	42.8	43.1	43.4	43.6	43.8	44.0	44.3	48.0	49.8	48.6	44.7	39.7	35.4	33.1	95.8
200.0	42.5	43.2	43.8	44.2	44.5	44.7	44.9	45.0	45.2	49.0	50.8	49.6	45.6	40.7	36.4	34.1	96.8
250.0	43.6	44.3	44.8	45.2	45.5	45.7	45.8	46.0	46.2	50.0	51.8	50.6	46.7	41.7	37.4	35.2	97.8
315.0	44.6	45.3	45.8	46.2	46.4	46.6	46.8	47.0	47.2	51.0	52.8	51.6	47.7	42.8	38.4	36.2	98.8
400.0	45.5	46.2	46.8	47.2	47.4	47.7	47.9	48.1	48.3	52.0	53.8	52.6	48.7	43.8	39.4	37.2	99.8
500.0	46.6	47.3	47.8	48.2	48.5	48.7	48.9	49.1	49.3	53.0	54.8	53.6	49.7	44.8	40.5	38.2	100.9
630.0	47.6	48.3	48.8	49.2	49.5	49.7	49.9	50.1	50.3	54.1	55.9	54.8	50.8	45.9	41.5	39.2	101.9
800.0	48.6	49.3	49.8	50.2	50.5	50.7	50.9	51.2	51.4	55.0	56.8	55.3	51.4	46.4	42.0	39.8	102.8
1000.0	49.6	50.3	50.9	51.3	51.6	51.7	51.8	51.7	51.9	55.6	57.4	56.2	52.3	47.4	43.0	40.8	103.6
1250.0	50.6	51.2	51.7	51.9	52.1	52.2	52.4	52.6	52.8	56.6	58.4	57.2	53.3	48.4	44.1	41.8	104.6
1600.0	51.1	51.8	52.3	52.7	53.0	53.2	53.4	53.6	53.9	57.6	59.4	58.2	54.3	49.4	45.1	42.8	105.6
2000.0	52.1	52.8	53.3	53.7	54.0	54.3	54.5	54.6	54.9	58.6	60.5	59.3	55.4	50.5	46.2	43.9	106.7
2500.0	53.1	53.8	54.3	54.7	55.0	55.2	55.4	55.6	55.9	59.7	61.5	60.3	56.5	51.7	47.4	45.2	107.8
3150.0	54.0	54.7	55.2	55.6	56.0	56.2	56.5	56.7	57.0	61.0	63.0	62.1	58.5	53.7	49.5	47.4	109.4
4000.0	54.9	55.6	56.2	56.6	57.0	57.4	57.9	58.4	59.0	63.1	65.2	64.2	60.6	55.9	51.8	49.7	111.5
5000.0	56.2	57.0	57.7	58.4	59.0	59.5	60.1	60.6	61.2	65.5	67.8	67.2	63.6	58.9	54.8	52.7	114.2
6300.0	58.1	58.9	59.7	60.3	61.0	61.7	62.4	63.4	64.1	68.2	70.3	69.3	65.7	61.0	56.8	54.7	117.0
8000.0	60.1	61.0	61.9	62.9	63.6	64.2	64.8	65.3	65.9	70.0	72.3	71.4	67.8	63.2	59.1	57.0	119.6
10000.0	62.3	63.2	63.9	64.5	65.1	65.8	66.4	67.1	67.8	72.1	74.3	73.4	69.9	65.4	61.3	59.3	122.4
12500.0	63.5	64.4	65.2	66.0	66.7	67.4	68.1	68.8	69.[illegible]	74.0	76.5	75.8	72.4	68.0	64.1	62.1	125.7
16000.0	64.6	65.5	66.3	67.1	67.9	68.8	69.7	70.6	71.7	76.4	79.1	76.8	75.4	71.0	67.1	65.1	130.0
20000.0	65.1	66.0	66.8	68.2	69.2	70.1	71.1	72.8	74.1	78.8	81.7	81.2	77.8	73.3	69.3	67.3	134.9

++++++++++																	
OA(20-20K)																	
LINEAR	71.4	72.2	73.0	73.9	74.7	75.4	76.2	77.2	78.2	82.8	85.4	84.8	81.4	76.9	72.9	70.9	136.9
A-SCALE	68.1	68.9	69.6	70.3	71.0	71.6	72.2	73.0	73.7	78.1	80.4	79.7	76.2	71.7	67.6	65.6	130.1
++++++++++																	
OA(50-10K)																	
LINEAR	67.3	68.1	68.8	69.5	70.0	70.6	71.1	71.7	72.3	76.4	78.6	77.7	74.1	69.5	65.4	63.3	125.9
A-SCALE	66.6	67.4	68.1	68.7	69.3	69.8	70.3	70.9	71.4	75.6	77.7	76.8	73.2	68.5	64.4	62.3	124.8
++++++++++																	
PERCEIVED NOISE LEVL																	
PNL	79.1	79.9	80.6	81.1	81.7	82.2	82.7	83.3	83.9	87.9	90.0	89.0	85.3	80.6	76.4	74.3	
PNLTC	79.2	80.0	80.6	81.2	81.7	82.2	82.8	83.4	83.9	88.0	90.1	89.1	85.4	80.7	76.5	74.4	

*****STATIC LEVELS AT AMBIENT CORRECTED TO FAA STD DAY CONDITIONS (77 DEG F, 70 PCT RH) FOR FLYOVER PREDICTIONS ONLY

MITSUBISHI MU2J/TPE331 NOISE PREDICTION AT FAR36 1000 FT LEVEL FLYOVER

NOISE SOURCE= PROP ** DISTANCE = 100.0 ** ONE-THIRD OCTAVE BAND AND OVERALL ENGINE COMPONENT SOURCE NOISE LEVEL SUMMARY

1/3 OCTAVE BAND CENTER FREQUENCY	SOUND PRESSURE LEVEL,DB MIKE LOCATIONS IN DEGREES 10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.	SOUND POWER LEVEL,DB
20.0	21.8	21.7	21.5	21.2	20.7	19.8	18.5	17.1	16.8	18.7	21.6	24.3	26.5	28.2	29.4	30.3	74.3
25.0	23.8	23.7	23.5	23.2	22.7	21.8	20.5	19.1	18.8	20.7	23.6	26.3	28.5	30.2	31.4	32.3	76.3
31.5	25.8	25.7	25.5	25.2	24.7	23.8	22.5	21.1	20.8	22.7	25.6	28.3	30.5	32.2	33.4	34.3	78.3
40.0	27.8	27.7	27.5	27.2	26.7	25.8	24.5	23.1	22.8	24.7	27.6	30.2	32.4	34.1	35.4	36.3	80.3
50.0	29.8	29.7	29.5	29.2	28.7	27.8	26.5	25.1	24.7	26.6	29.6	32.3	34.4	36.2	37.4	38.3	82.3
63.0	31.8	31.7	31.5	31.2	30.6	29.8	28.5	27.1	26.8	28.7	31.6	18.0	28.8	38.4	45 0	48.7	88.2
80.0	33.7	33.7	33.5	33.2	32.7	31.8	30.5	12.3	28.7	47.2	63.8	93.3	92.0	91.1	85.5	83.3	136.1
100.0	35.8	35.7	35.5	17.3	30.0	46.3	63.7	96.4	99.3	96.1	92.8	57.1	48.1	41.8	38.2	37.2	142.6
125.0	49.6	58.2	68.5	99.2	99.1	101.0	96.7	51.1	32.7	19.5	19.7	28.6	36.9	44.3	49.2	51.7	144.2
160.0	90.3	98.5	97.3	59.4	43.3	25.7	17.1	22.2	34.7	49.8	63.2	86.7	85.3	83.7	78.9	75.8	137.8
200.0	31.4	25.2	23 3	27.9	37.0	49.7	63.4	89.9	91.8	89.3	86.2	56.3	49.9	47.7	49.6	51.3	135.6
250.0	52.4	59.7	68.0	92.7	92.6	93.6	89.9	51.0	38.5	48.3	60.1	82.6	82.4	80.6	77.2	73.6	137.6
315.0	83.1	91.9	90.7	58.8	46.4	48.7	60.4	86.3	88.6	89.0	88.5	84.3	81.6	78.3	74.3	70.2	136.1
400.0	51.4	57.7	64.6	88.8	90.9	91.7	91.7	87.4	86.3	85.2	83.9	82.4	79.8	76.5	72.6	68.6	137.6
500.0	81.6	92.2	93.3	90.6	89.6	88.2	87.1	85.5	84.5	[illegible]3.6	82.3	80.6	78.1	75.1	71.4	67.6	137.2
630.0	77.9	88.1	88.7	88.7	87.8	86.5	85.5	83.8	83.1	82.6	81.9	81.6	79.4	76.4	72.6	68.7	135.1
800.0	76.3	86.5	87.1	86.9	86.3	85.3	85.0	84.9	84.4	83.6	82.4	80.2	77.6	74.5	70.8	67.0	134.4
1000.0	75.2	85.7	86.7	97.9	87.5	86.5	85.5	83.3	82.4	81.7	80.7	79.8	77.5	74.4	70.7	67.0	134.3
1250.0	76.3	86.5	87.1	86.5	85.7	84.5	83.8	83.1	82.3	81.5	80.2	78.3	75.7	72.6	69.9	65.5	133.4
1600.0	74.4	84.6	85.5	86.1	85.5	84.3	83.3	81.4	80.[illegible]	79.7	78.6	78.7	75.7	72.2	68.1	64.6	132.6
2000.0	74.2	84.3	85.0	84.5	83.7	82.5	81.7	81.9	80	77.1	72.7	61.3	58.3	57.0	57.1	57.6	131.1
2500.0	72.5	82.6	83.3	85.0	83.4	80.7	75.9	58.5	49 [illegible]	45.6	47.1	54.2	55.6	56.6	57.3	57.8	128.6
3150.0	71.0	79.4	77.6	66.1	59.2	52.0	47.4	50.9	49.[illegible]	50.2	52.0	53.7	55.0	55.9	56.5	56.9	118.6
4000.0	59.7	56.8	55.3	58.9	57.5	55.5	53.1	50.5	48.9	49.5	51.2	52.8	54.0	54.8	55.4	55.8	105.8
5000.0	61.2	60.7	60.0	58.8	57.3	55.2	52.7	49.9	48.2	48.7	50.3	51.7	52.8	53.6	54.1	54.5	106.3
6300.0	60.8	60.4	59.5	58.3	56.6	54.4	51.7	48.8	46.9	47.3	48.8	50.2	51.2	51.9	52.4	52.7	105.8
8000.0	60.1	59.5	58.6	57.3	55.5	53.2	50.4	47.3	45.3	45.6	46.9	48.2	49.1	49.8	50.2	50.5	105.2
10000.0	58.8	58.2	57.2	55.8	53.8	51.4	48.4	45.2	43.1	43.3	44.6	45.8	46.7	47.3	47.7	47.9	104 4
12500.0	56.9	56 2	53.1	53.6	51.6	9.0	45.9	42.6	40.6	40.5	41.7	42.8	43.7	44.3	44.7	44.9	103.3
16000.0	54.1	53.4	52.3	50.6	48.5	45.8	42.6	39.2	36.9	36.9	38.1	39.2	40.1	40.6	41.0	41.3	102.1
20000.0	50.4	49.7	48.5	46.7	44.4	41.7	38.4	34.9	32.6	32.6	33.7	34.9	35.7	36.2	36.6	36.9	100.7

++++++++++																	
OA(20-20K)																	
LINEAR	92.3	101.1	100.8	101.9	101.7	102.8	99.7	99.0	101.0	98.5	96.1	95.9	94.3	92.8	87.8	85.1	149.7
A-SCALE	86.4	96.2	96.8	96.6	96.1	95.4	94.2	92.6	92.2	91.2	89.9	88.3	86.0	83.1	79.3	75.9	143.5
++++++++++																	
OA(50-10K)																	
LINEAR	92.3	101.1	100.8	101.9	101.7	102.8	99.7	99.0	101.0	98.5	96.1	95.9	94.3	92.8	87.8	85.1	149.7
A-SCALE	86.4	96.2	96.8	96.6	96.1	95.4	94.2	92.6	92.2	91.2	89.9	88.3	86.0	83.1	79.3	75.9	143.5
++++++++++																	
PERCEIVED NOISE LEVL																	
PNL	97.3	105.6	105.8	106.4	105.4	105.6	103.4	101.7	102.6	100.6	99.2	97.7	96.0	94.4	90.4	88.0	
PNLTC	103.0	112.0	111.3	109.8	108.7	108.9	106.7	105.1	105.9	103.9	102.6	101.0	99.3	97.7	93.8	91.3	

*****STATIC LEVELS AT AMBIENT CORRECTED TO FAA STD DAY CONDITIONS (77 DEG F, 70 PCT RH) FOR FLYOVER PREDICTIONS ONLY

MITSUBISHI MU2J/TPE331 NOISE PREDICTION AT FAR36 1000 FT LEVEL FLYOVER

NOISE SOURCE= TOTL ** DISTANCE = 100.0 ** ONE-THIRD OCTAVE BAND AND OVERALL ENGINE COMPONENT SOURCE NOISE LEVEL SUMMARY

1/3 OCTAVE BAND CENTER FREQUENCY	SOUND PRESSURE LEVEL,DB MIKE LOCATIONS IN DEGREES 10.	20.	30.	40.	50.	60.	70.	80.	90.	100.	110.	120.	130.	140.	150.	160.	SOUND POWER LEVEL,DB
20.0	65.3	65.2	65.5	64.8	62.1	58.3	51.7	48.8	45.8	45.1	45.3	44.9	44.6	46.2	48.7	47.8	108.8
25.0	66.1	66.0	66.3	65.7	62.9	59.2	52.7	49.9	47.5	47.2	47.6	47.7	47.7	49.4	51.2	49.7	109.7
31.5	67.0	66.9	67.2	66.5	63.8	60.1	53.8	51.5	49.7	49.9	50.6	50.9	51.1	52.3	53.1	51.7	110.7
40.0	67.9	67.8	68.1	67.6	64.9	61.3	55.3	53.3	52.3	53.0	53.8	54.3	54.6	55.2	54.9	53.9	111.8
50.0	69.0	68.9	69.2	68.7	66.0	62.4	56.8	55.3	55.2	56.4	57.3	58.0	58.3	58.3	57.0	55.8	113.2
63.0	70.0	69.9	70.2	69.5	66.9	63.5	58.6	58.0	58.5	59.8	60.7	61.2	61.4	61.1	59.3	58.0	114.6
80.0	70.9	70.8	71.2	70.6	68.1	64.7	60.9	60.6	61.5	63.0	66.8	93.3	92.0	91.1	85.5	83.3	136.2
100.0	72.0	71.9	72.3	71.8	69.3	66.4	66.4	96.4	99.3	96.1	92.8	67.9	67.7	66.5	64.1	61.3	142.6
125.0	73.1	73.1	74.6	99.2	99.1	101.0	96.7	66.3	67.5	68.9	69.7	70.2	70.2	69.3	66.5	63.6	144.2
160.0	90.4	98.5	97.3	74.1	71.9	69.7	68.1	68.6	70.0	71.4	72.7	86.9	85.5	83.9	79.3	76.2	137.9
200.0	75.1	75.1	75.5	75.2	73.3	71.5	71.1	89.9	91.9	89.4	86.5	75.1	75.0	73.9	70.8	67.6	135.9
250.0	76.2	76.3	77.2	92.8	92.7	93.6	90.0	73.3	74.6	75.8	76.4	83.5	83.3	81.7	78.3	74.8	137.9
315.0	84.1	92.0	90.9	77.6	76.2	75.0	74.5	86.6	88.8	89.2	88.8	85.2	83.0	80.4	76.6	72.8	136.6
400.0	78.3	78.4	79.0	89.2	91.0	91.8	91.8	87.7	86.8	85.9	84.8	83.5	81.4	78.8	75.0	71.2	138.0
500.0	83.6	92.4	93.5	91.0	90.0	88.5	87.4	85.9	85.1	84.3	83.2	81.8	79.8	77.3	73.7	70.0	137.6
630.0	82.3	88.8	89.4	89.3	88.3	86.9	85.8	84.2	83.6	83.2	82.6	82.3	80.3	77.6	73.9	70.1	135.7
800.0	82.2	87.6	88.1	87.9	87.0	85.8	85.3	85.1	84.6	83.9	82.8	80.7	78.4	75.6	71.8	68.1	135.0
1000.0	82.8	87.2	88.0	88.8	88.1	86.9	85.7	83.6	82.7	81.9	81.0	80.2	77.9	75.0	71.3	67.6	135.0
1250.0	83.7	88.1	88.6	87.9	86.7	85.1	84.0	83.2	82.5	81.6	80.4	78.6	76.1	73.1	69.5	65.9	134.3
1600.0	84.1	87.1	87.7	87.9	86.7	85.0	83.6	81.6	80.7	79.8	78.8	78.9	75.9	72.4	68.3	64.8	133.7
2000.0	84.8	87.3	87.8	87.2	85.6	83.6	82.1	82.0	80.2	77.3	73.2	64.8	62.0	59.9	58.5	58.3	132.8
2500.0	85.0	86.7	87.2	87.6	85.5	82.4	77.0	68.1	64.3	63.2	63.3	62.5	60.4	58.9	58.3	58.2	131.5
3150.0	85.2	86.0	85.9	84.5	81.7	77.8	71.0	68.0	64.4	63.8	64.3	63.4	60.8	58.6	57.6	57.5	129.3
4000.0	85.4	85.2	85.5	84.8	82.1	78.2	71.6	68.6	65.2	65.0	65.9	64.8	61.8	58.8	57.2	56.8	129.5
5000.0	85.9	85.8	86.1	85.5	82.8	79.0	72.4	69.3	66.3	66.8	68.2	67.5	64.2	60.3	57.7	56.8	130.3
6300.0	86.4	86.3	86.6	85.8	83.2	79.6	73.3	70.8	68.1	69.3	70.7	69.5	66.0	61.8	58.4	57.0	131.2
8000.0	86.8	86.8	87.3	86.9	84.5	81.1	75.1	72.5	70.1	71.3	72.7	71.8	68.3	63.9	60.2	58.4	132.8
10000.0	88.1	88.2	88.8	88.2	86.2	83.4	78.0	76.4	73.9	74.1	75.0	74.1	70.5	66.1	62.2	60.1	135.3
12500.0	90.1	90.5	91.5	92.1	90.4	87.6	81.9	80.7	76.7	73.8	76.8	75.8	72.5	68.1	64.2	62.2	139.9
16000.0	93.8	94.0	94.9	96.2	93.3	88.7	80.4	73.8	72.4	76.6	79.1	78.8	75.5	71.0	67.1	65.1	144.7
20000.0	95.5	95.7	96.6	87.1	82.1	76.4	72.2	73.6	74.3	78.9	81.7	81.2	77.8	73.3	69.3	67.3	145.3

++++++++++																	
OA(20-20K)																	
LINEAR	101.2	103.9	104.1	104.1	103.1	103.3	100.0	99.3	101.1	98.8	96.8	96.5	94.9	93.4	88.6	85.9	152.6
A-SCALE	97.7	99.9	100.4	100.0	98.5	96.9	94.8	93.1	92.7	91.8	90.8	89.4	87.2	84.5	80.7	77.4	146.9
++++++++++																	
OA(50-10K)																	
LINEAR	97.8	102.4	102.2	102.9	102.4	103.0	99.9	99.2	101.1	98.7	96.5	[illegible]	94.8	93.3	88.5	85.7	150.4
A-SCALE	96.6	99.2	99.6	99.3	97.9	96.5	94.6	93.0	92.6	91.7	90.6	[illegible]	[illegible]	84.3	80.6	77.2	145.4
++++++++++																	
PERCEIVED NOISE LEVL																	
PNL	110.0	111.8	112.1	112.2	110.5	109.2	106.0	104.4	104.9	103.3	102.3	100.7	98.7	96.7	92.5	89.8	
PNLTC	112.7	115.2	115.4	115.6	113.9	112.5	109.4	107.8	108.2	106.6	105.0	102.7	100.5	98.4	94.0	91.3	

2.5	4721.4	1000.0	4825.3	11.9	11.9	CENT	62.0	62.8	55.5	52.8
						COMB	48.8	49.6	43.8	40.9
						JET	33.6	34.1	28.9	23.4
						ATUR	30.8	31.3	23.5	21.0
						PROP	63.1	69.3	63.3	53.9
						TOTL	67.0	69.9	64.0	56.5
3.0	4531.4	1000.0	4639.5	12.4	12.4	CENT	62.7	63.5	56.1	53.6
						COMB	49.5	50.3	44.6	41.8
						JET	34.1	34.6	29.3	24.0
						ATUR	31.4	31.9	24.1	21.7
						PROP	64.0	70.3	64.0	55.0
						TOTL	67.8	70.8	64.7	57.5
29.5	-5538.6	1000.0	5627.5	169.8	10.2	CENT	24.2	24.2	13.0	14.0
						COMB	40.4	41.0	39.3	31.3
						JET	27.1	27.3	24.1	14.8
						ATUR	24.3	24.7	13.3	14.0
						PROP	46.8	48.9	44.3	35.3
						TOTL	48.6	50.0	45.5	36.8

NASA LEWIS RESEARCH CENTER PAGE 11
NASA GASP NOISE MODULE OUTPUT

MITSUBISHI MU2J/TPE331 NOISE PREDICTION AT FAR36 1000 FT LEVEL FLYOVER

AIRCRAFT NOISE LEVEL PREDICTIONS AT MINIMUM SLANT DISTANCE

TIME SEC	RANGE FEET	ALTITUDE FEET	SLANT DIST,FT	ENGINE-OBSERVER ANGLE,DEG	ELEV ANGLE DEG	COMPONENT	PNL DB	PNLTC DB	OVERALL DB	A-WEIGHTED DB(A)
15.0	-28.6	1000.0	996.4	91.6	88.4	CENT	66.1	66.6	54.3	53.6
						COMB	74.2	74.8	69.2	64.7
						JET	52.7	53.2	46.6	42.1
						ATUR	61.3	61.8	48.8	48.5
						PROP	86.4	89.7	79.6	75.8
						TOTL	88.0	91.3	80.0	76.1

****

MITSUBISHI MU2J/TPE331 NOISE PREDICTION AT FAR36 1000 FT LEVEL FLYOVER

****

SUMMARY OUTPUT OF PREDICTED NOISE LEVELS

****

COMPONENT	EPNL DB	MAX PNLTC DB	TIME AT MAX PNLTC	ANGLE,DEG MAX PNLTC	DUR CORR	DUR TIME	MAX PNL	TIME AT MAX PNL	ANGLE,DEG MAX PNL	MAX OVERALL DB	TIME AT MAX OVERALL	MAX A-WEIGHTED DB	TIME AT MAX A-WEIGHTED
CENT	77.5	82.5	12.0	41.9	-5.0	6.5	81.6	12.0	41.9	70.5	12.0	69.6	12.0
COMB	70.8	74.8	15.0	91.6	-4.0	8 5	74.4	15.5	102.4	69.7	15.5	64.8	15.5
JET	49.7	53.2	15.0	91.6	-3.4	10.0	52.7	15.0	91.6	46.6	15.0	42.1	15.0
ATUR	58.9	65.9	16.0	112.3	-7.0	5.0	65.4	16.0	112.3	52.7	16.0	52.3	16.0
PROP	87.4	91.8	13.5	61.5	-4.4	10.0	88.5	13.5	61.5	86.7	13.5	77.7	13.5
TOTL	89.1	93.8	13.5	61.5	-4.7	8.5	90.5	13.5	61.5	86.8	13.5	78.1	13.5

*****MAXIMUM TURBOPROP FLYOVER NOISE LEVEL IS 75.5 DB(A)

(PERFORMANCE CORRECTIONS ARE INCLUDED.)

****

*****FLYOVER AIRCRAFT NOISE PREDICTION CASE COMPLETED*****

****

*****FLYOVER NOISE LEVELS INCLUDE A DOPPLER SHIFT.

```
*******************************************************************************************************
                MITSUBISHI MU2J/TPE331 NOISE PREDICTION AT FAR36 1000 FT LEVEL FLYOVER
*******************************************************************************************************
***********************
CABIN NOISE PREDICTIONS *
***********************

PROP DIAMETER(FT)   =   8.17    NO BLADES           =      4
HORSEPOWER          =  665.0    RPM                 = 1591.0
TIP CLEARANCE(FT)   =   1.00    AXIAL DISTANCE(FT)  =    0.0
VELOCITY(KNOTS)     =  225.1    ALTITUDE(FT)        =  1000.
OUTSIDE AIR TEMP(F) =   59.0    CABIN PRES(PSI)     =    0.0
DIST AFT FOR BL CALC=  10.00

 CALCULATED CONSTANTS

PARTIAL '.EVEL 1    = 137.56    PARTIAL LEVEL 2     =   0.12
NO OF BLADES CORR   =   0.0     AXIAL CORR          =   0.0
ALTITUDE CORR       =  -0.15    XOD,YOD             = 0.0 , 0.12
ROTATIONAL TIP MACH =  0.609    HELICAL TIP MACH    =  0.698
PRESSURIZTION CORR  =   0.0     BLADE SWEEP CORR    =   0.0
```

HARMONIC	FREQUENCY	A-WATE	HARMONIC WT	T-LOSS	EXTERIOR SPL NEAR-FIELD	INTERIOR SPL (CABIN)
1	106.)	-18.26	-0.79	33.00	139.73	109.73
2	212.1	-10.27	-9.74	33.00	130.78	100.78
3	318.2	-6.52	-14.59	33.00	125.93	95.93
4	424.3	-4.36	-20.89	33.74	119.63	88.89
5	530.3	-2.84	-27.02	36.96	113.50	79.54
6	636.4	-1.85	-32.46	40.18	108.06	70.88
7	742.5	-1.12	-39.18	43.40	101.34	60.94
8	848.5	-0.57	-47.54	46.62	92.98	49.36
9	954.6	-0.15	-55.80	49.84	84.72	37.88
10	1060.7	0.18	-65.88	50.00	74.64	27.64
A-WEIGHTED SPL					125.92	95.73
OVERALL SPL					140.46	110.44

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BOUNDARY LAYER NOISE

BAND	FREQ	SPL-OUT	SPL-IN
1	10.0	94.00	61.00
2	12.5	95.00	62.00
3	16.0	96.00	63.00
4	20.0	97.00	64.00
5	25.0	98.00	65.00
6	31.5	99.00	66.00
7	40.0	100.00	67.00
8	50.0	101.00	68.00
9	63.0	102.00	69.00
10	80.0	103.00	70.00
11	100.0	104.00	71.00
12	125.0	105.00	72.00
13	160.0	106.00	73.00
14	200.0	107.00	74.00
15	250.0	108.00	75.00
16	315.0	109.00	76.00
17	400.0	110.00	77.00
18	500.0	111.00	74.97
19	630.0	112.00	72.02
20	800.0	113.00	67.86
21	1000.0	114.00	64.00
22	1250.0	114.50	64.50
23	1600.0	115.00	65.00
24	2000.0	115.50	65.50
25	2500.0	116.00	66.00
26	3150.0	116.20	66.20
27	4000.0	116.40	66.40
28	5000.0	116.50	66.50
29	6300.0	116.40	66.40
30	8000.0	116.20	66.20
31	10000.0	116.00	66.00
32	12500.0	115.40	65.40
33	16000.0	114.60	64.60
34	20000.0	113.60	63.60
A-WEIGHTED SPL =		127.13	80.47
OVER-ALL SPL =		127.77	85.35

TOTAL BOUNDARY LAYER AND PROPELLER NOISE INSIDE CABIN
110.46 DB   95.86 DB(A)

```
                                          NASA LEWIS RESEARCH CENTER                          PAGE  14
                                         NASA GASP NOISE MODULE OUTPUT
************************************************************************************************************************************
                         MITSUBISHI MU2J/TPE331 NOISE PREDICTION AT FAR36 1000 FT LEVEL FLYOVER
************************************************************************************************************************************
++++++++++INPUT VARIABLE STATUS AT JOB END+++++
++++++++++INPUT VARIABLE STATUS AT JOB END+++++
                                    INPUT DATA - USER INPUT AND DEFAULT VALUES USED
************************************************************************************************************************************
CONTROL VARIABLES  *
********************

IFAA= 4   FLYOVER ,     IPOUT= 3   FULL    ,                ISTAG= 3            ICAB= 1             ISI= 0  (ENGL UNITS)

************************
ENVIRONMENTAL VARIABLES*
************************

TAMB=518.7          PAMB= 2116.2        RH= 70.             DIST= 100.0         NLOC= 16

ANGLE (ARRAY) =  10.0  20.0  30.0  40.0  50.0  60.0  70.0  80.0  90.0 100.0 110.0 120.0 130.0 140.0 150.0 160.0


************************
ENGINE/AIRCRAFT SYSTEM *
************************

+++++ENGINE VARIABLES+++++
ENGINE TYPE(NTYE)= 3  (PROP)  .......................ENGINE COMPONENT ARRAY(ICOMP) =     3    4    5    6    8    0
                                                                                          CENF COMB JET  ATUR PROP NONE

+++++AIRFRAME VARIABLES+++++
AMACH=0.34          VEL= 380.0          ENP= 2.             ANENGI=  0.0        ANENGE=  0.0        XL=  1.0
YL=  1.0            ZL=  1.0            WGMAX= 10800.       LOCENG= 2           IPHASE= 0           IDOP= 1

****************
FLIGHT PROFILE *
****************

IDPRO= 0                                VEL= 380.0          AMACH=0.34          FLTANG= 0.0         ANGAFT= 0.0
TOROLL=    0.       APDIST= 5671.4      XALT=1000.

*****A STRAIGHT LINE PROFILE WILL BE COMPUTED FROM A COMBINATION OF THE ABOVE VARIABLES.

****************
FLIGHT OPTIONS *
****************

KGOLD=  0           XLSIDE=     0.0     XRSIDE=     0.0     IQS=  1             ICUT=  0            IPSEUD=  0
IDUR= 0             XTOL= 100.          IWING= 0
XFAA= 7516.,21325.,21325.,    0.,       YFAA=    4.,    4.,    4.,    4.,       ZFAA=    0.,    0., 1476.,    0.,

D50= 2400.0         RC=1880.0           VY= 13065.0
```

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**************************************************************************************************************************************
                              MITSUBISHI MU2J/TPE331 NOISE PREDICTION AT FAR36 1000 FT LEVEL FLYOVER
**************************************************************************************************************************************
++++++++++INPUT VARIABLE STATUS AT JOB END+++++
++++++++++INPUT VARIABLE STATUS AT JOB END+++++
***********************************
ENGINE COMPONENT VARIABLES AT INPUT*
***********************************

+++++CENF+++++
DTLE= 0.555       DHLE= 0.208       T1= 518.7         P1=  2116.0       RPMC= 41730.0     CMASS=   7.78
DELTC= 0.6100     NBC= 17           CMASSD=   7.78    RPMCD= 41730.0    CAECN= 40.0       AMACH=0.3403

+++++COMB+++++
WACOMB=   7.78    T3=1124.7         T4=2166.6         P3= 17675.0       CAEC= 20.0
AMACH=0.340

+++++JET +++++
VJ= 621.0         TJ=1371.9         DJ= 0.8360        HJ=0.41800        GAMJ=1.3330       VJ2=   0.0
TJ2=   0.0        DJ2= 0.0          HJ2=0.0           GAMJ2=1.4010      EL2=  0.0         ALFAJ= 0.0
PHIJ= 0.0         V0= 380.0         INVOPT= 0

+++++ATUR+++++
RPMT= 41730.0     DT= 0.750         DH= 0.477         ACNZ= 0.263       NBT= 44           DTOT=0.28800
PRTS= 0.0         GAMAT=1.33300     CAET= 40.0        AMACH=0.340

+++++PROP+++++
DIAP=  8.17       NBP=  4           SHP= 665.00       RPMP= 1591.0      ALTIT=1000.0      CAEP= 40.0
VEL= 380.0        AMACH=0.340       BLTH=0.0400       BLCH=0.6000       BLAK= 5.0000      BLAREA=  6.0000

***** A DOPPLER FREQUENCY SHIFT WILL BE APPLIED TO ALL SOURCE STATIC SPECTRA AS A FUNCTION OF FLIGHT MACH NO. AND ANGLE FROM INLET.
```

APPENDIX A

Sample Test Case 5

Near Field and Cabin Noise Predictions for a
Turboprop-Powered Executive Aircraft

```
                                    NASA LEWIS RESEARCH CENTER                              PAGE  16
                                   NASA GASP NOISE MODULE OUTPUT
******************************************************************************************************************************
                         CABIN NOISE TEST CASE, AERO COMMANDER 680E
******************************************************************************************************************************
                                        INPUT DATA - USER INFUT AND DEFAULT VALUES USED
******************************************************************************************************************************
CONTROL VARIABLES  *
********************

IFAA= 7   CABIN DB,     IPOUT= 3   FULL     ,                ISTAG= 3           ICAB= 1            ISI= 0  (ENGL UNITS)

***********************
ENVIRONMENTAL VARIABLES*
***********************

TAMB=515.0          PAMB= 2116.2       RH= 70.             DIST= 100.0        NLOC= 16

ANGLE (ARRAY) =  10.0  20.0  30.0  40.0  50.0  60.0  70.0  80.0  90.0 100.0 110.0 120.0 130.0 140.0 150.0 160.0


***********************
ENGINE/AIRCRAFT SYSTEM *
***********************

+++++ENGINE VARIABLES+++++
ENGINE TYPE(NTYE)= 4  (OTHR)  .......................ENGINE COMPONENT ARRAY(ICOMP) =     8    4    5    6    8    9
                                                                                      PROP COMB JET  ATUR PROP NONE

+++++AIRFRAME VARIABLES+++++
AMACH=0.24          VEL= 270.0          ENP= 2.             ANENGI=  0.0       ANENGE=  0.0       XL=  1.0
YL=  1.0            ZL=  1.0            WGMAX= 10800.       LOCENG= 2          IPHASE= 0          IDOP= 1
```

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CABIN NOISE TEST CASE, AERO COMMANDER 680E

CABIN NOISE PREDICTIONS *

PROP DIAMETER(FT)	= 7 75	NO BLADES	= 3
HORSEPOWER	= 243.7	RPM	= 1765.0
TIP CLEARANCE(FT)	= 0.38	AXIAL DISTANCE(FT)	= 0.0
VELOCITY(KNOTS)	= 160.0	ALTITUDE(FT)	= 7500.
OUTSIDE AIR TEMP(F)	= 55.3	CABIN PRES(PSI)	= 0.0
DIST AFT FOR BL CALC	= 10.00		

CALCULATED CONSTANTS

PARTIAL LEVEL 1	= 131.93	PARTIAL LEVEL 2	= 8.15
NO OF BLADES CORR	= 2.50	AXIAL CORR	= 0.0
ALTITUDE CORR	= -1.15	XOD,YOD	= 0.0 , 0.05
ROTATIONAL TIP MACH	= 0.644	HELICAL TIP MACH	= 0.688
PRESSURIZTION CORR	= 0.0	BLADE SWEEP CORR	= 0.0

HARMONIC	FREQUENCY	A-WATE	HARMONIC WT	T-LOSS	EXTERIOR SPL NEAR-FIELD	INTERIOR SPL (CABIN)
1	88.3	-20.98	-1.52	33.00	142.91	112.91
2	176.5	-12.29	-9.00	33.00	135.43	105.43
3	264.7	-8.07	-13.47	33.00	130.95	100.95
4	353.0	-5.72	-17.91	33.00	126.52	96.52
5	441.2	-4.07	-22.61	34.25	121.82	90.57
6	529.5	-2.85	-27.90	36.93	116.53	82.60
7	617.7	-2.00	-32.28	39.61	112.15	75.53
8	706.0	-1.35	-37.31	42.29	107.12	67.83
9	794.2	-0.83	-43.85	44.97	100.57	58.61
10	882.5	-0.42	-51.17	47.65	93.26	48.61
A-WEIGHTED SPL					128.89	98.65
OVERALL SPL					143.97	113.95

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BOUNDARY LAYER NOISE

BAND	FREQ	SPL-OUT	SPL-IN
1	10.0	88.28	55.28
2	12.5	89.28	56.28
3	16.0	90.28	57.28
4	20.0	91.28	58.28
5	25.0	92.28	59.28
6	31.5	93.28	60.28
7	40.0	94.28	61.28
8	50.0	95.28	62.28
9	63.0	96.28	63.28
10	80.0	97.28	64.28
11	00.0	98.28	65.28
12	125.0	99.28	66.28
13	160.0	100.28	67.28
14	200.0	101.28	68.28
15	250.0	102.28	69.28
16	315.0	103.28	70.28
17	400.0	104.28	71.28
18	500.0	105.28	69.25
19	630.0	106.28	66.30
20	800.0	106.78	61.64
21	1000.0	107.28	57.28
22	1250.0	107.78	57.78
23	1600.0	108.28	58.28
24	2000.0	108.48	58.48
25	2500.0	108.68	58.68
26	3150.0	108.78	58.78
27	4000.0	108.68	58.68
28	5000.0	108.48	58.48
29	6300.0	108.28	58.28
30	8000.0	107.68	[illegible]
31	10000.0	106.88	56.88
32	12500.0	105.88	55.88
33	16000.0	104.58	54.58
34	20000.0	102.98	52.98

A-WEIGHTED SPL	=	119.70	74.02
OVER-ALL SPL	=	120.25	79.36

TOTAL BOUNDARY LAYER AND PROPELLER NOISE INSIDE CABIN
113.96 DB 98.67 DB(A)

```
*******     ****************************************************************************************************************
                          CABIN NOISE TEST CASE, AERO COMMANDER 680E
**************  ************************************************************************************************************
++++++++++INPUT VARIABLE STATUS AT JOB END+++++
++++++++++INPUT VARIABLE STATUS AT JOB END+++++
                                    INPUT DATA - USER INPUT AND DEFAULT VALUES USED
****************************************************************************************************************************
CONTROL VARIABLES  *
*******************

IFAA= 7   CABIN DB,     IPOUT= 3   FULL                     ISTAG= 3            ICAB= 1            ISI= 0  (ENGL UNITS)

***********************
ENVIRONMENTAL VARIABLES*
***********************

TAMB=515.0          PAMB= 2116.2        RH= 70.             DIST= 100.0         NLOC= 16

ANGLE (ARRAY) =  10.0  20.0  30.0  40.0  50.0  60.0  70.0  80.0  90.0 100.0 110.0 120.0 130.0 140.0 150.0 160.0


***********************
ENGINE/AIRCRAFT SYSTEM *
***********************

+++++ENGINE VARIABLES+++++
ENGINE TYPE(NTYE)= 4  (OTHR)  .........................ENGINE COMPONENT ARRAY(ICOMP) =    8    4    5    6    8    0
                                                                                        PROP COMB JET  ATUR PROP NONE

+++++AIRFRAME VARIABLES+++++
AMACH=0.24          VEL= 270.0          ENP= 2.             ANENGI=  0.0        ANENGE=  0.0        XL=  1.0
YL=  1.0            ZL=  1.0            WGMAX= 10800.       LOCENG= 2           IPHASE= 0           IDOP= 1

***************
FLIGHT PROFILE *
***************

IDPRO= 0                                VEL= 270.0          AMACH=0.24          FLTANG= 0.0         ANGAFT= 0.0
TOROLL=     0.       APDIST= 5671.4     XALT=1000.

*****A STRAIGHT LINE PROFILE WILL BE COMPUTED FROM A COMBINATION OF THE ABOVE VARIABLES.

***************
FLIGHT OPTIONS *
***************

YGOLD=  0           XLSIDE=     0.0     XRSIDE=      0.0    IQS=  1             ICUT=  0            IPSEUD=  0
IDUR= 0             YTOL= 100.          IWING= 0
XFAA= 7516.,21325.,21325.,    0.,       YFAA=     4.,     4.,     4.,     4.,     ZFAA=     0.,     0., 1476.,     0.,
```

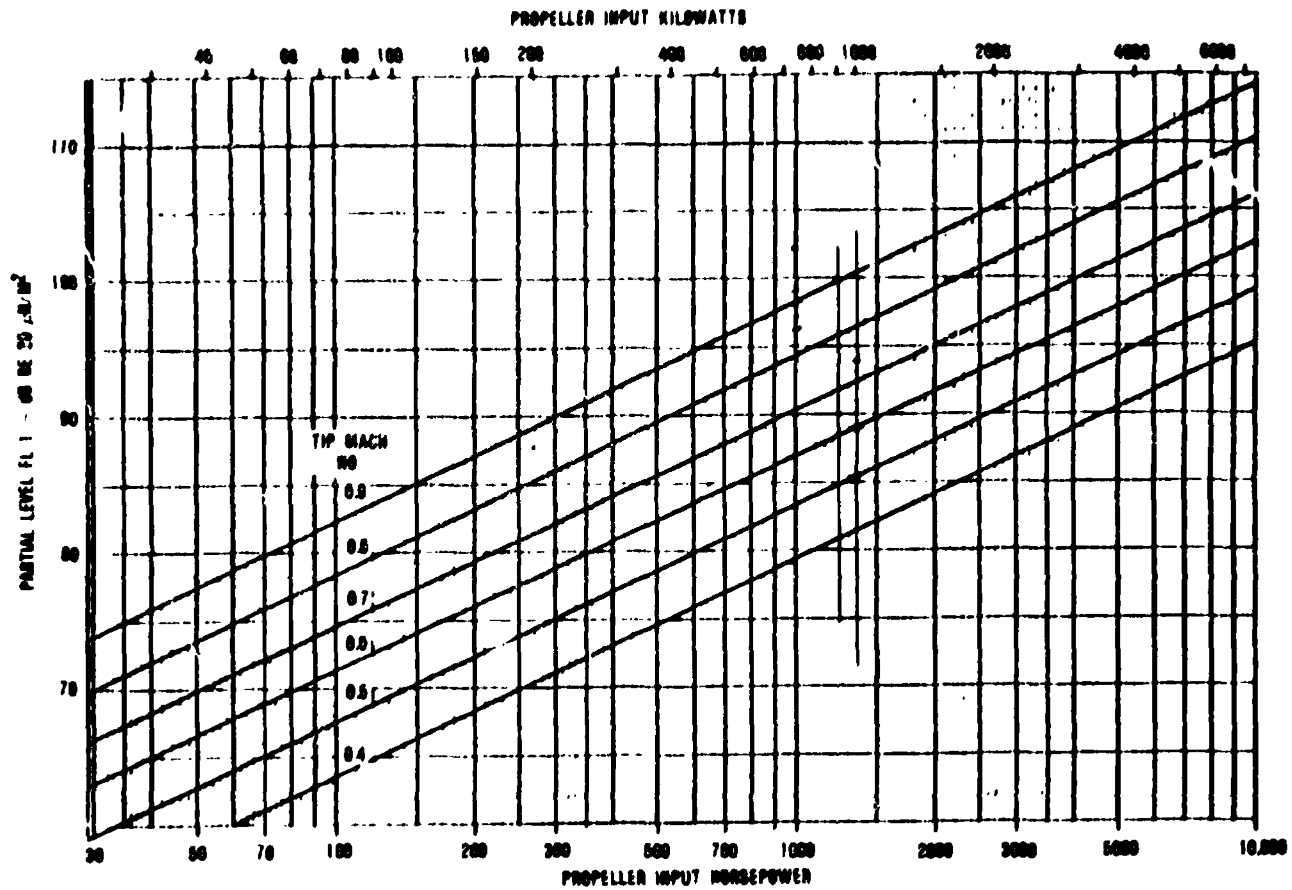
```
                                          NASA LEWIS RESEARCH CENTER                              PAGE  19
                                         NASA GASP NOISE MODULE OUTPUT
*****************************************************************************************************************************
                         CABIN NOISE TEST CASE, AERO COMMANDER 680E
*****************************************************************************************************************************
++++++++++INPUT VARIABLE STATUS AT JOB END+++++
++++++++++INPUT VARIABLE STATUS AT JOB END+++++
************************************
ENGINE COMPONENT VARIABLES AT INPUT*
************************************

+++++PROP+++++
DIAP=  7.75        NBP=  3           SHP= 243.75        RPMP= 1765.0        ALTIT=7500.0        CAEP= 40.0
VEL= 270.0         AMACH=0.243       BLTH=0.0400        BLCH=0.6000         BLAK= 5.0000        BLAREA=  6.0000

***** A DOPPLER FREQUENCY SHIFT WILL BE APPLIED TO ALL SOURCE STATIC SPECTRA AS A FUNCTION OF FLIGHT MACH NO. AND ANGLE FROM INLET.
```

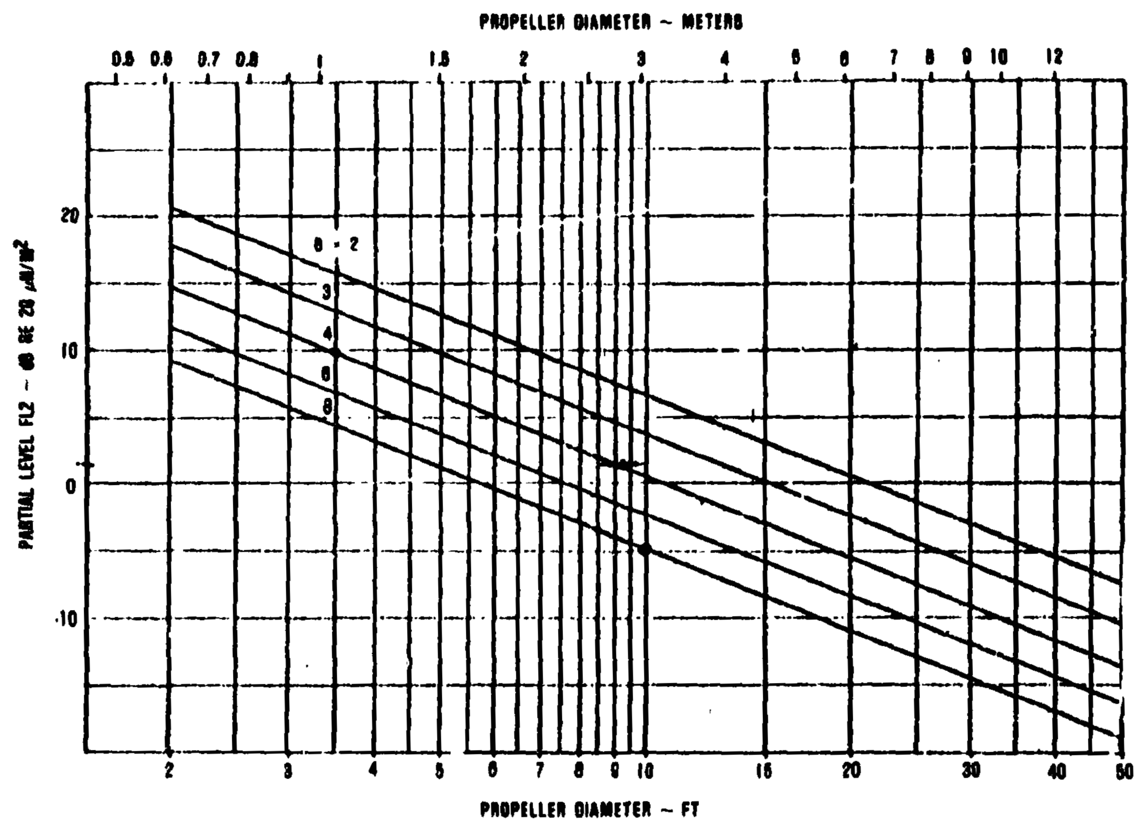
APPENDIX B

Compilation of Graphical Procedure Charts
for Propeller and Cabin Noise
Estimates, From References 12, 13 and 14



Far-Field Partial Level Based on Power and Tip Speed
(Figure 3 from Reference 12)

Figure 1, Ap. B



Far-Field Partial Noise Level Based on Blade Count and Propeller Diameter
(Figure 4 from Reference 12)

Figure 2, Ap. B

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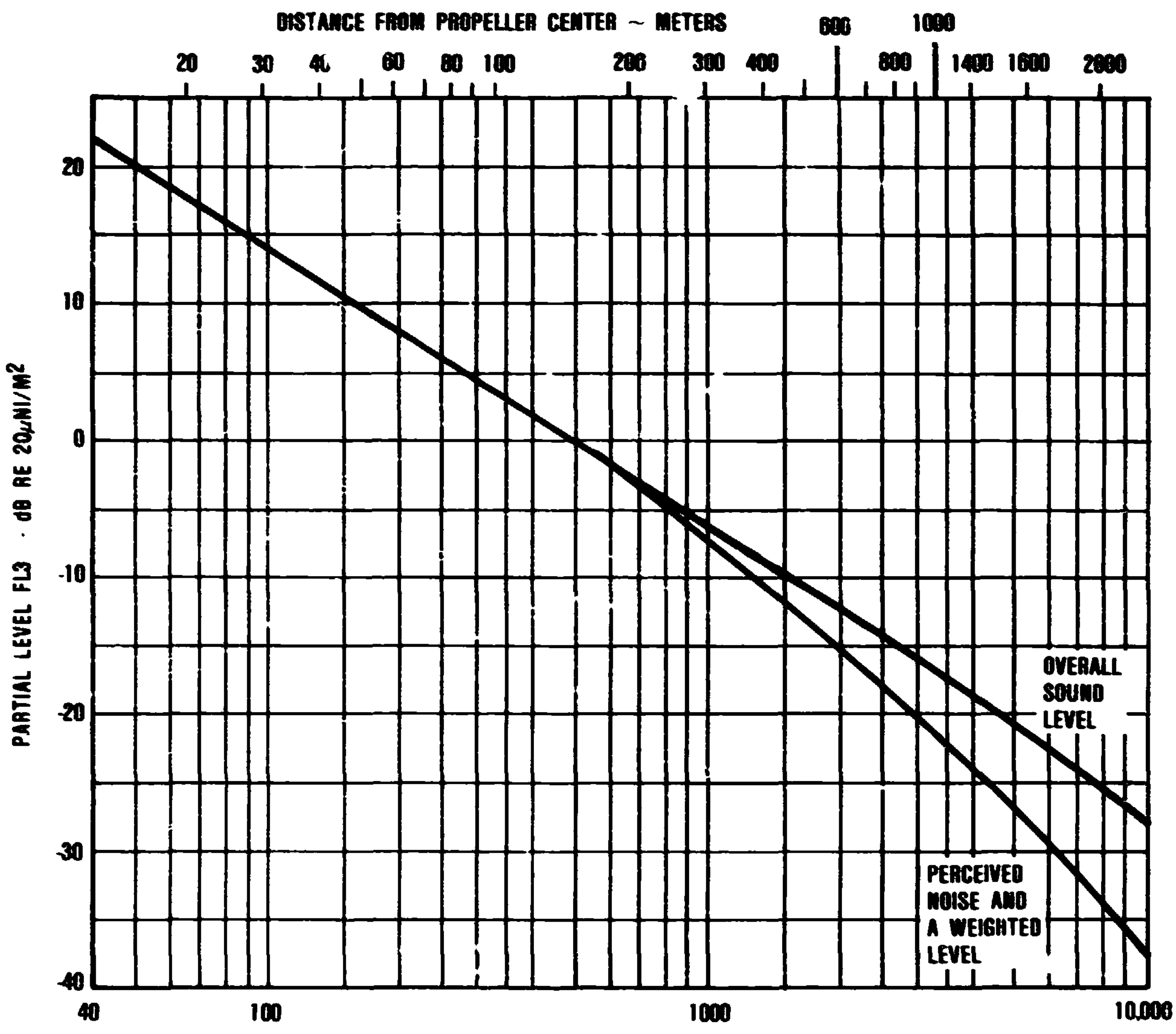
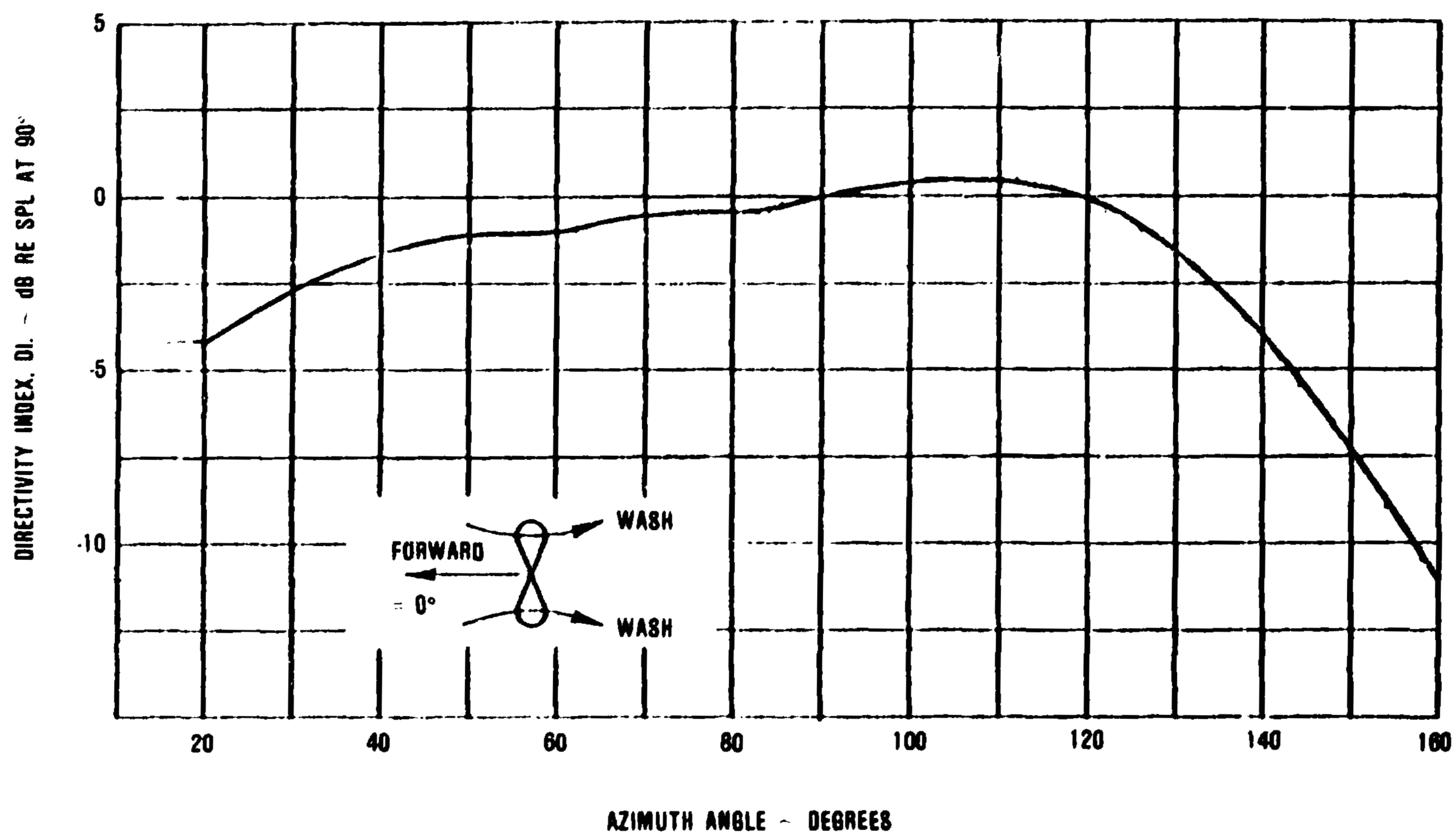


Atmospheric Absorption and Spherical Spreading of Sound

(Figure 5 from Reference 12)

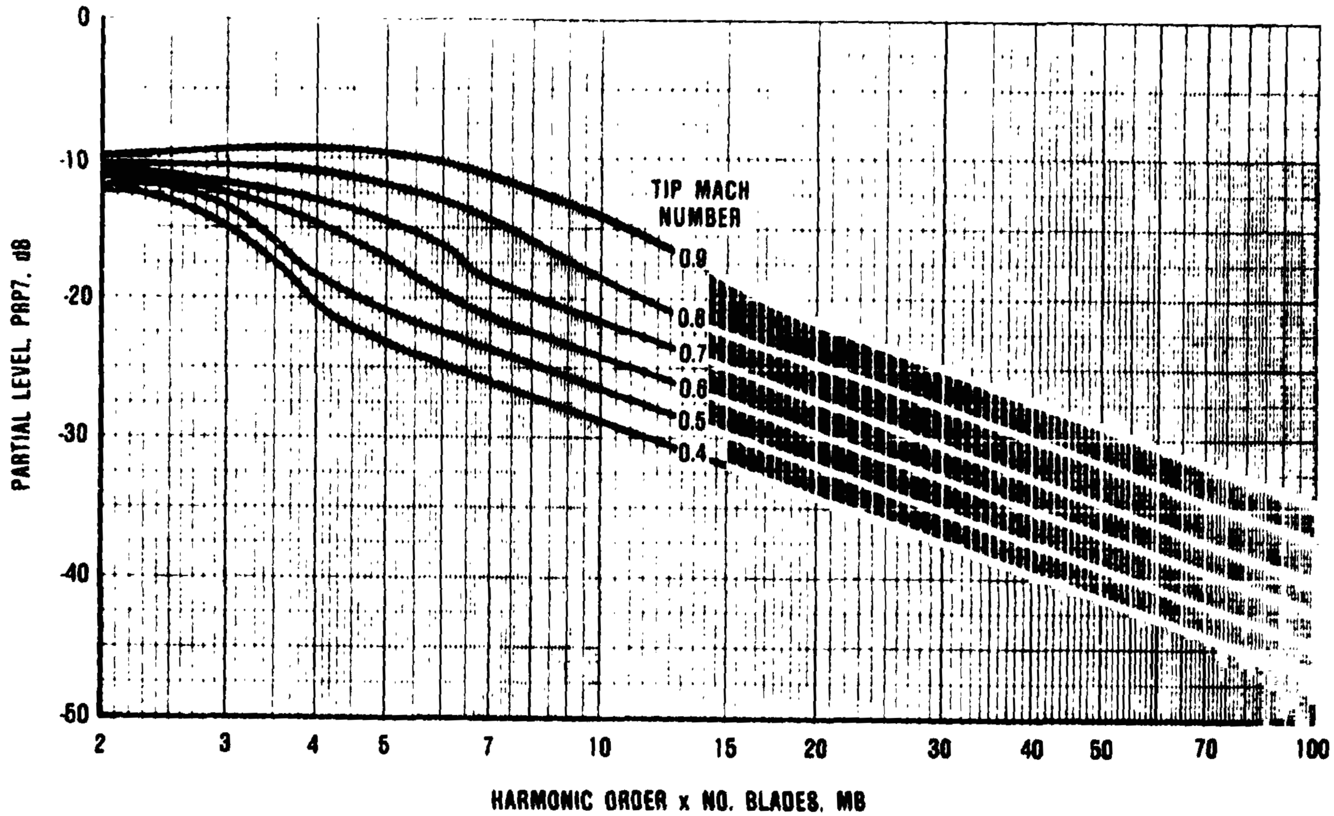
Figure 3, Ap. B



Directivity Index

(Figure 6 from Reference 12)

Figure 4, Ap. B



Revised Figure PRP11. Partial Level PRP 7 Based on Harmonic Order

(Figure B-1 from Reference 13)

Figure 5, Ap. B

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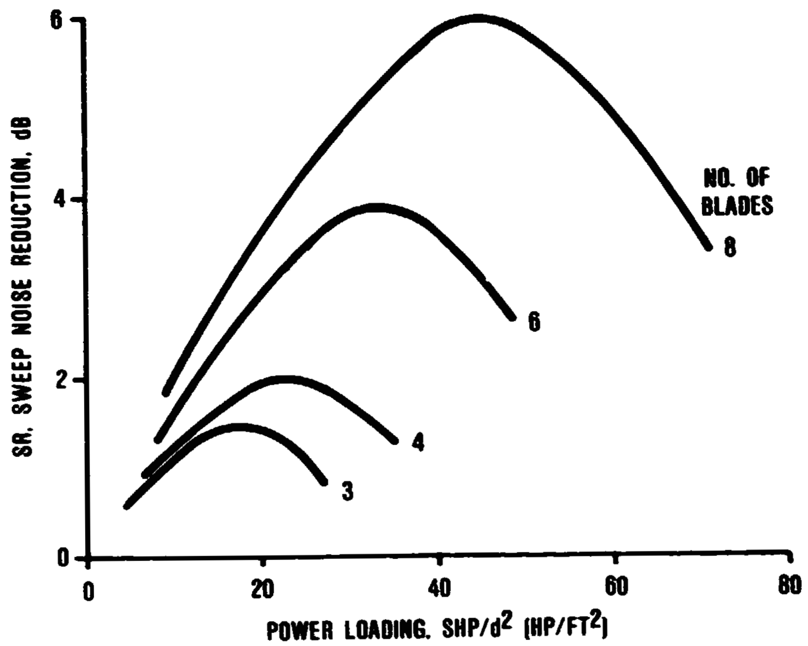
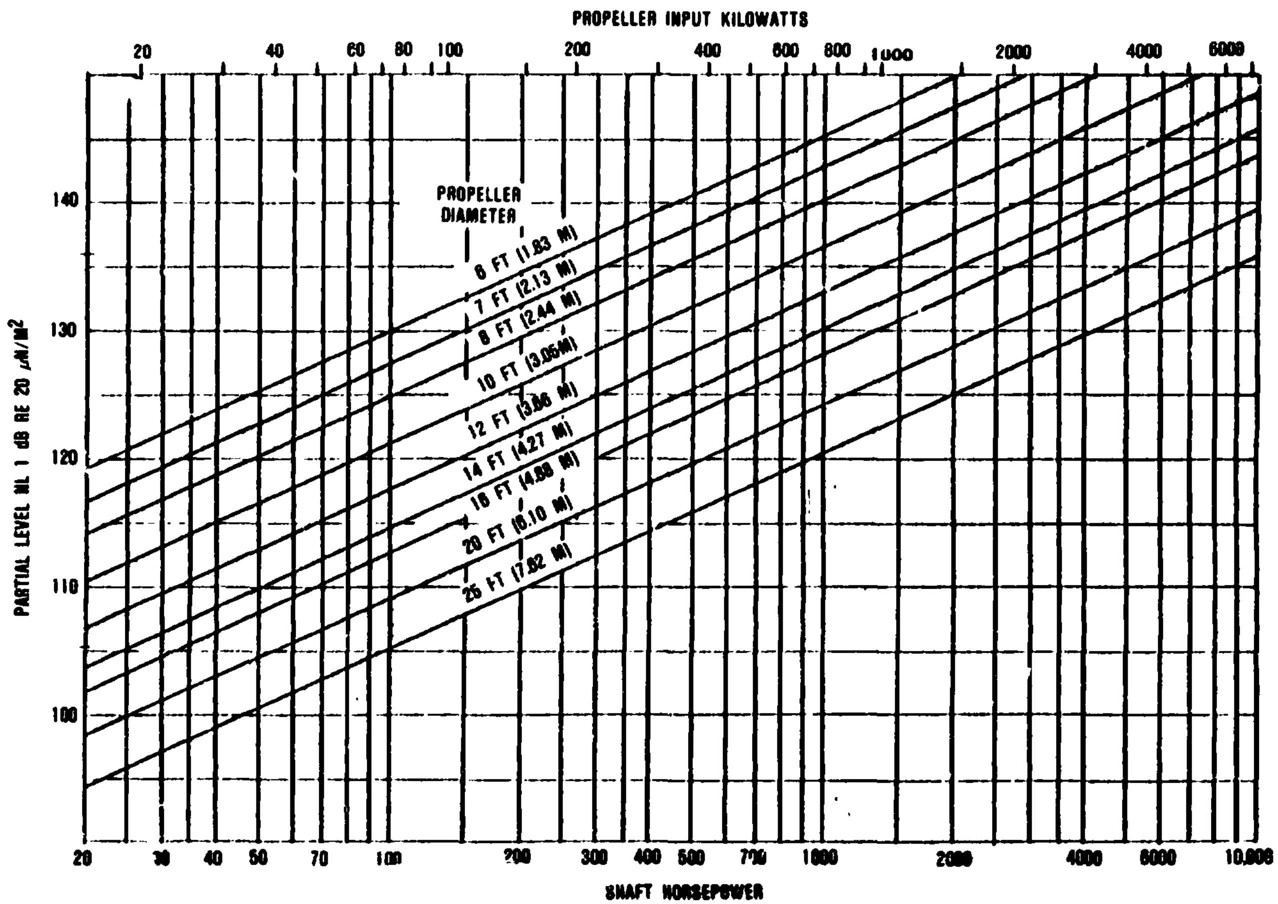


Sweep Correction to Overall Far-Field Noise Level of Current Technology Propellers

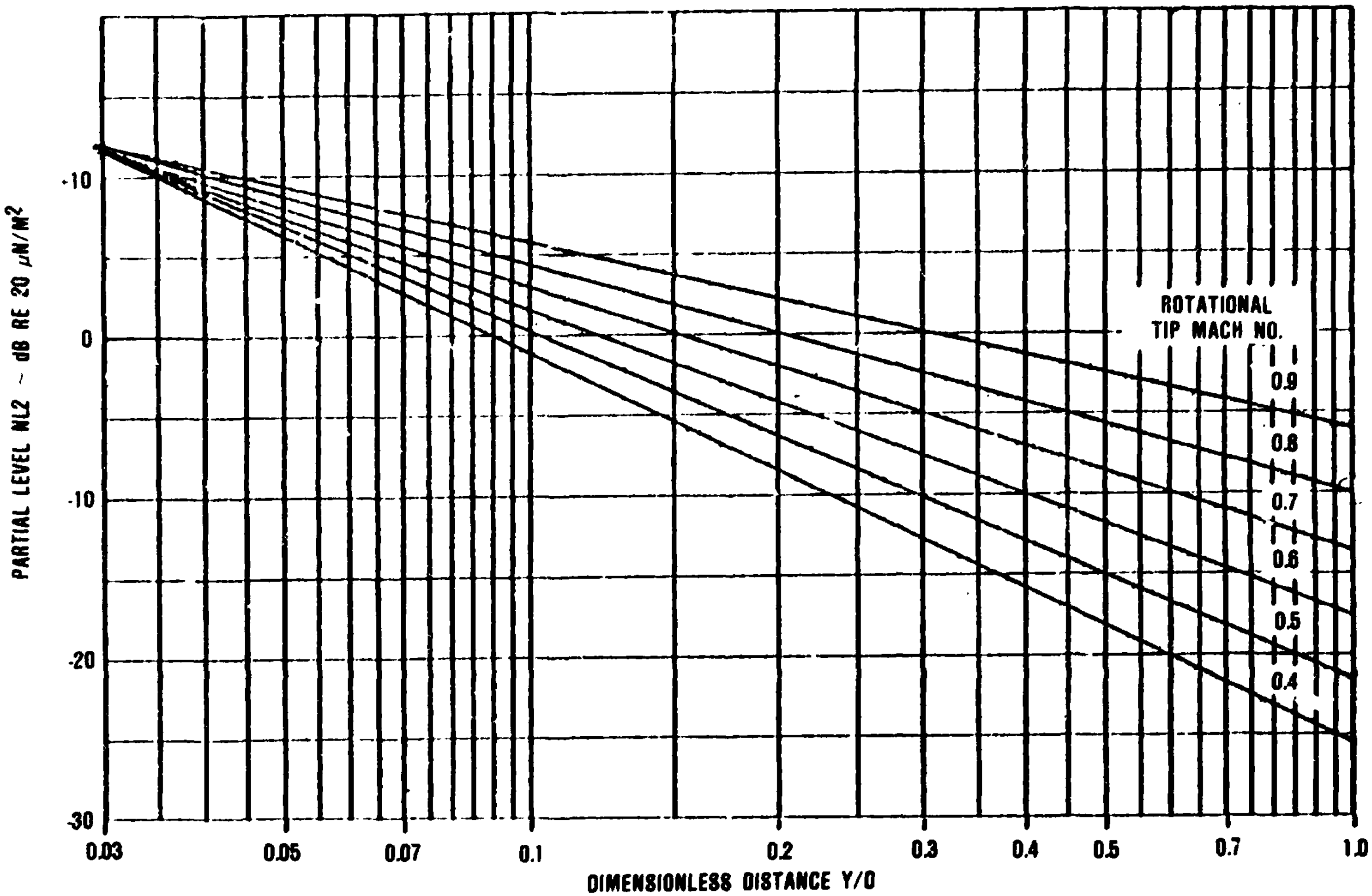
(Figure 22 from Reference 14)

Figure 6, Ap. B



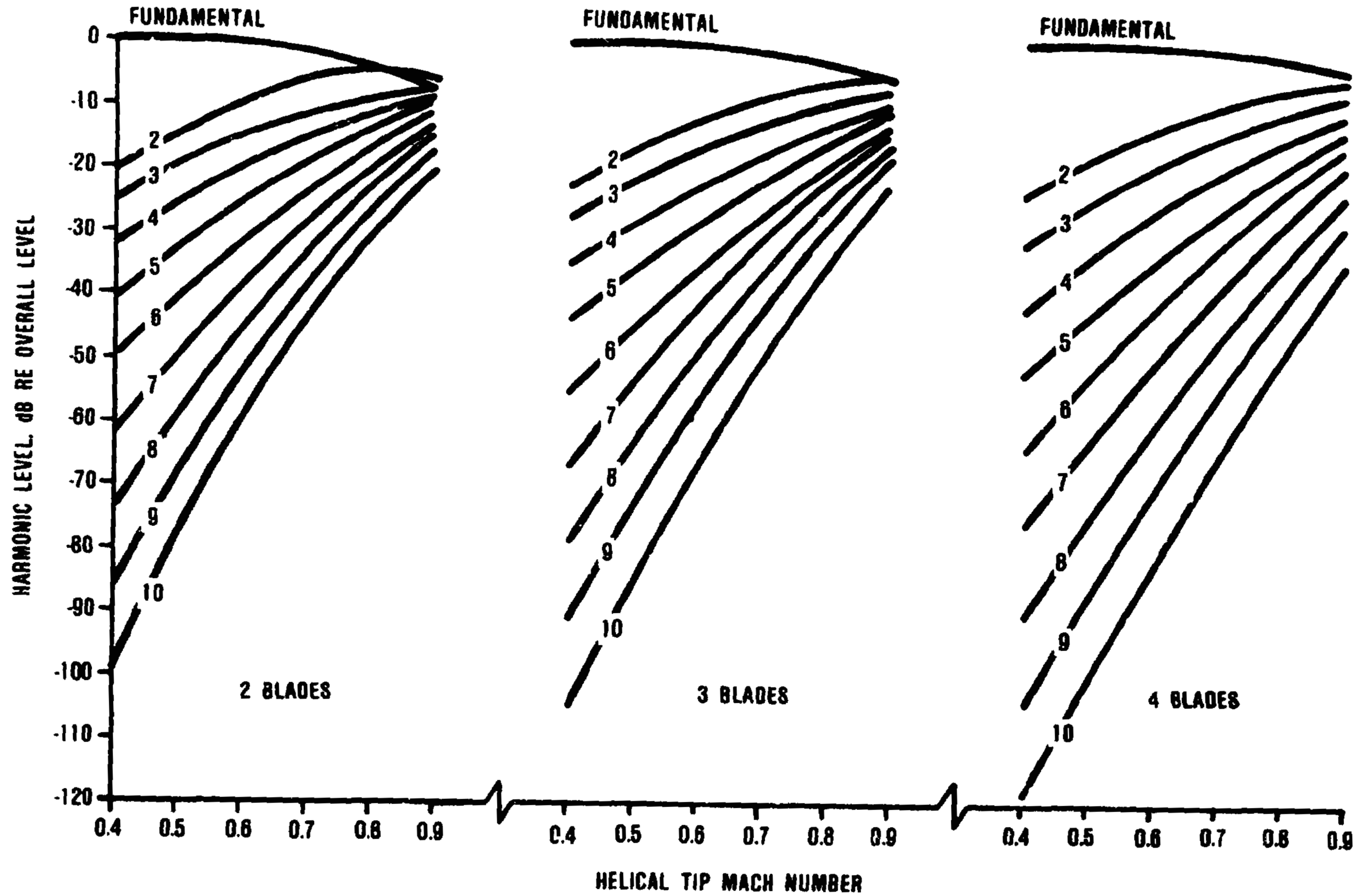
Near-Field Partial Level Based on Power and Diameter
(Figure 23 from Reference 14)

Figure 7, Ap. B



Near-Field Partial Level Based on Tip Speed and Tip Clearance
(Figure 24 from Reference 14)

Figure 8, Ap. B



Near-Field Harmonic Level Distribution -2, -3, and -4 Bladed Propellers
(Figure 27 from Reference 14)

Figure 9, Ap. B

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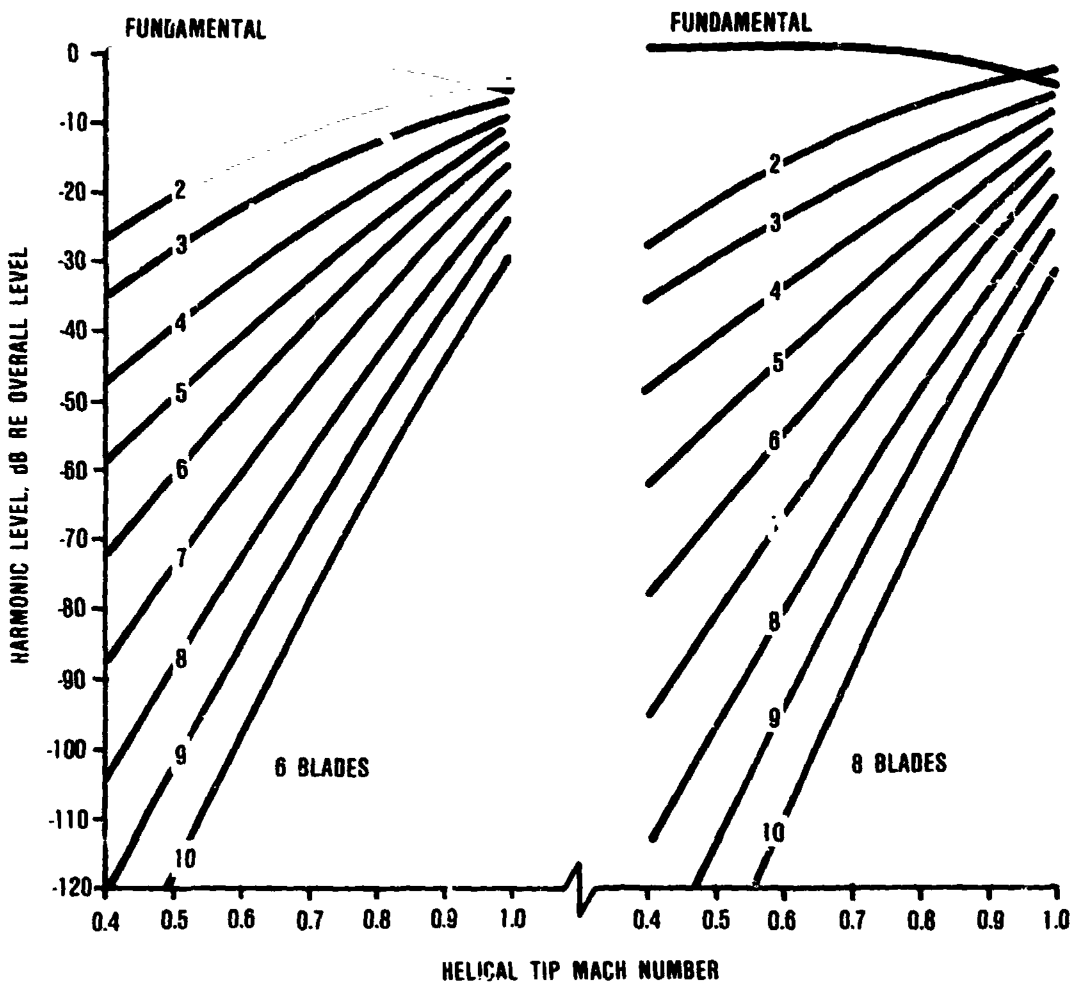
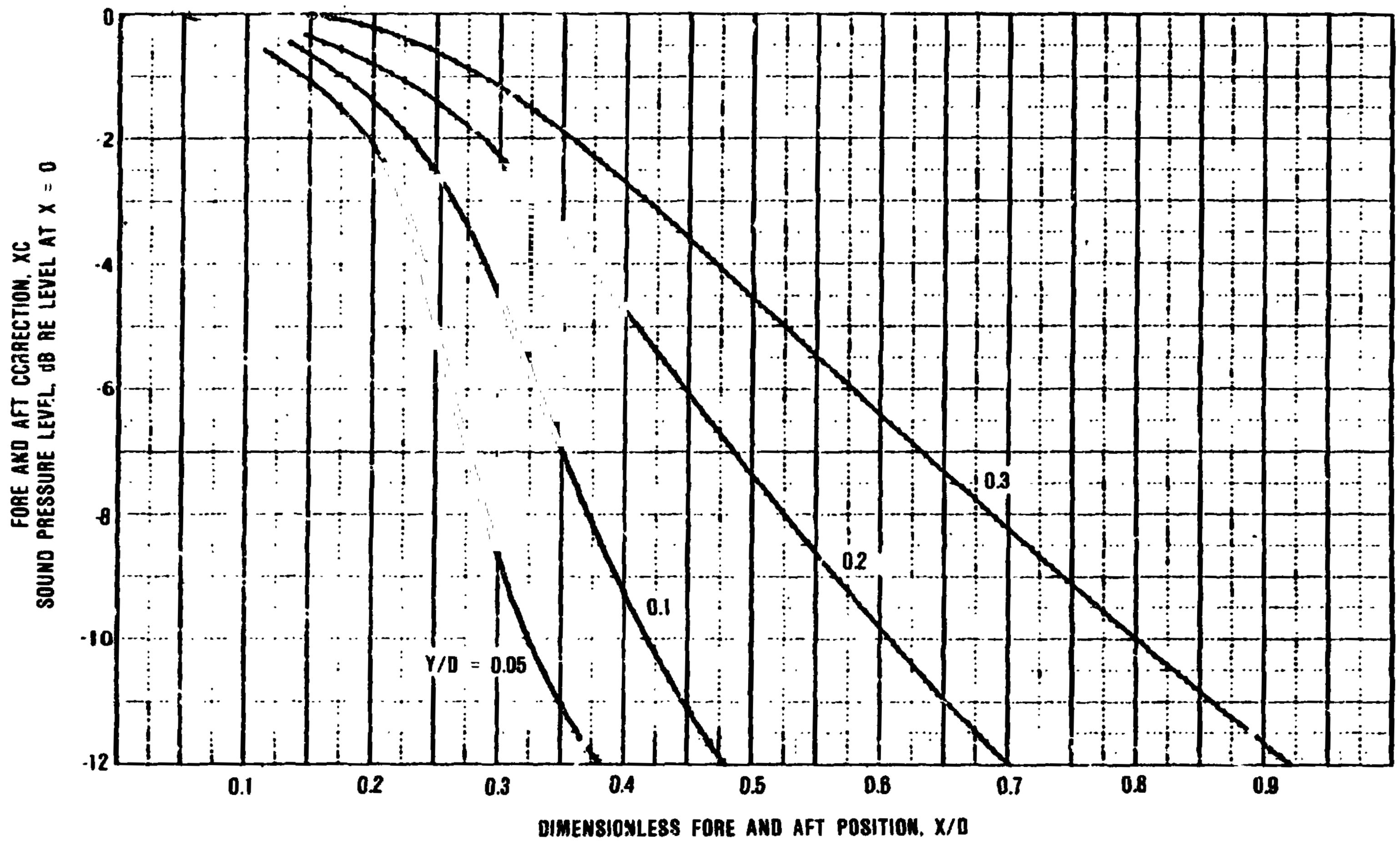


Near-Field Harmonic Level Distribution -6 and -8 Bladed Propellers (Cont'd)
(Figure 27 from Reference 14)

Figure 9, Ap. B (Continued)



Variation of Overall, Free-Space Propeller Noise Levels
with Axial Position X/D Fore and Aft of Propeller Plane

(Figure 25 from Refer[illegible]ce 1[illegible])

Figure 10, Ap. B

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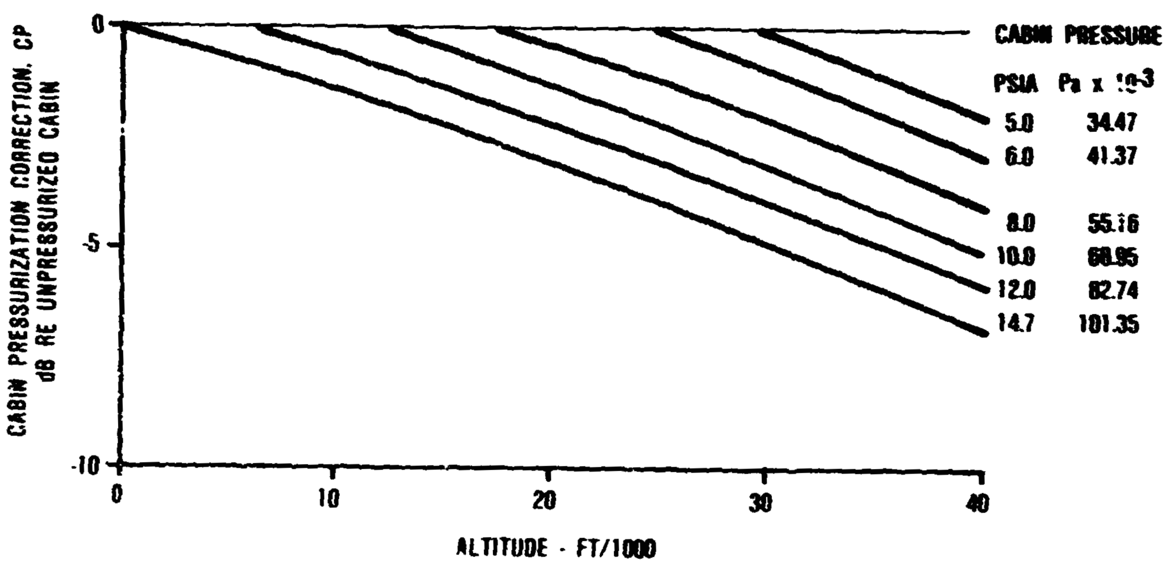
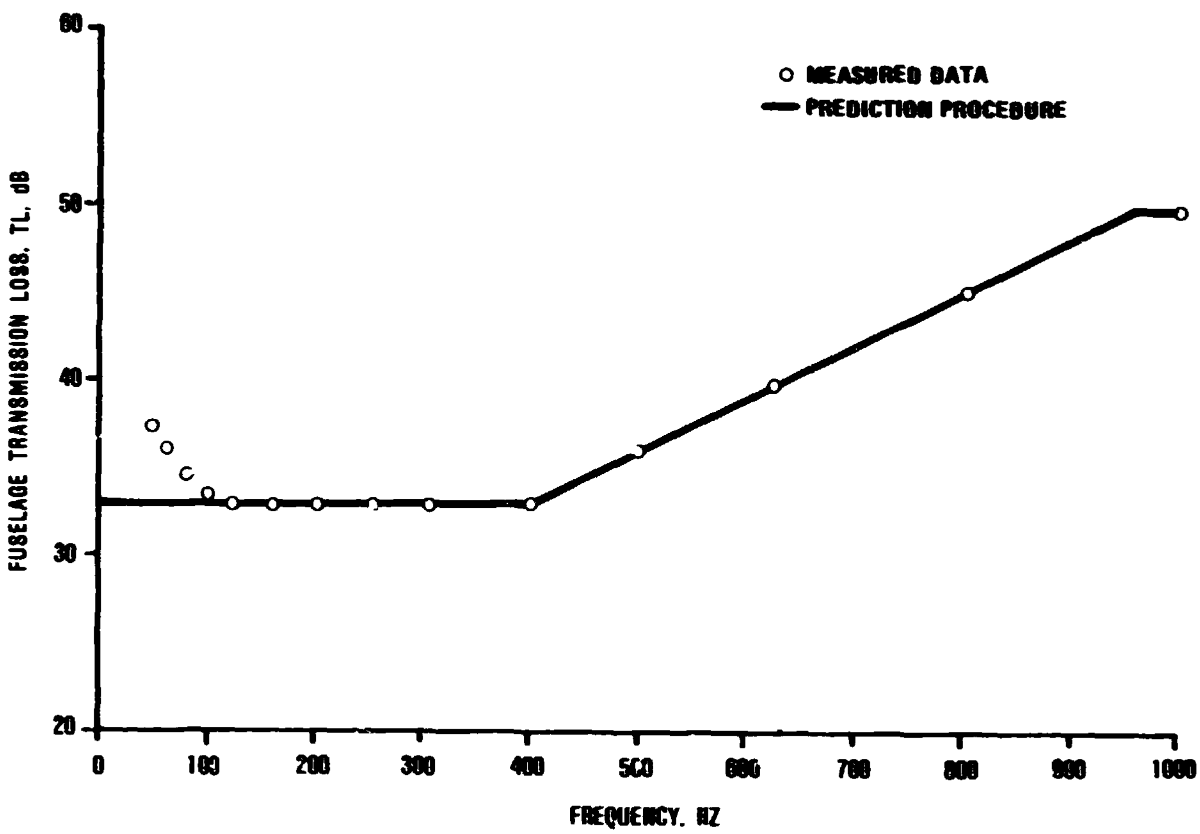


Effect of Cabin Pressure on Interior Noise Level
(Figure 30 from Reference 14)

Figure 11, Ap. B



Fuselage Transmission Loss
(Figure 29 from Reference 14)

Figure 12, Ap. B

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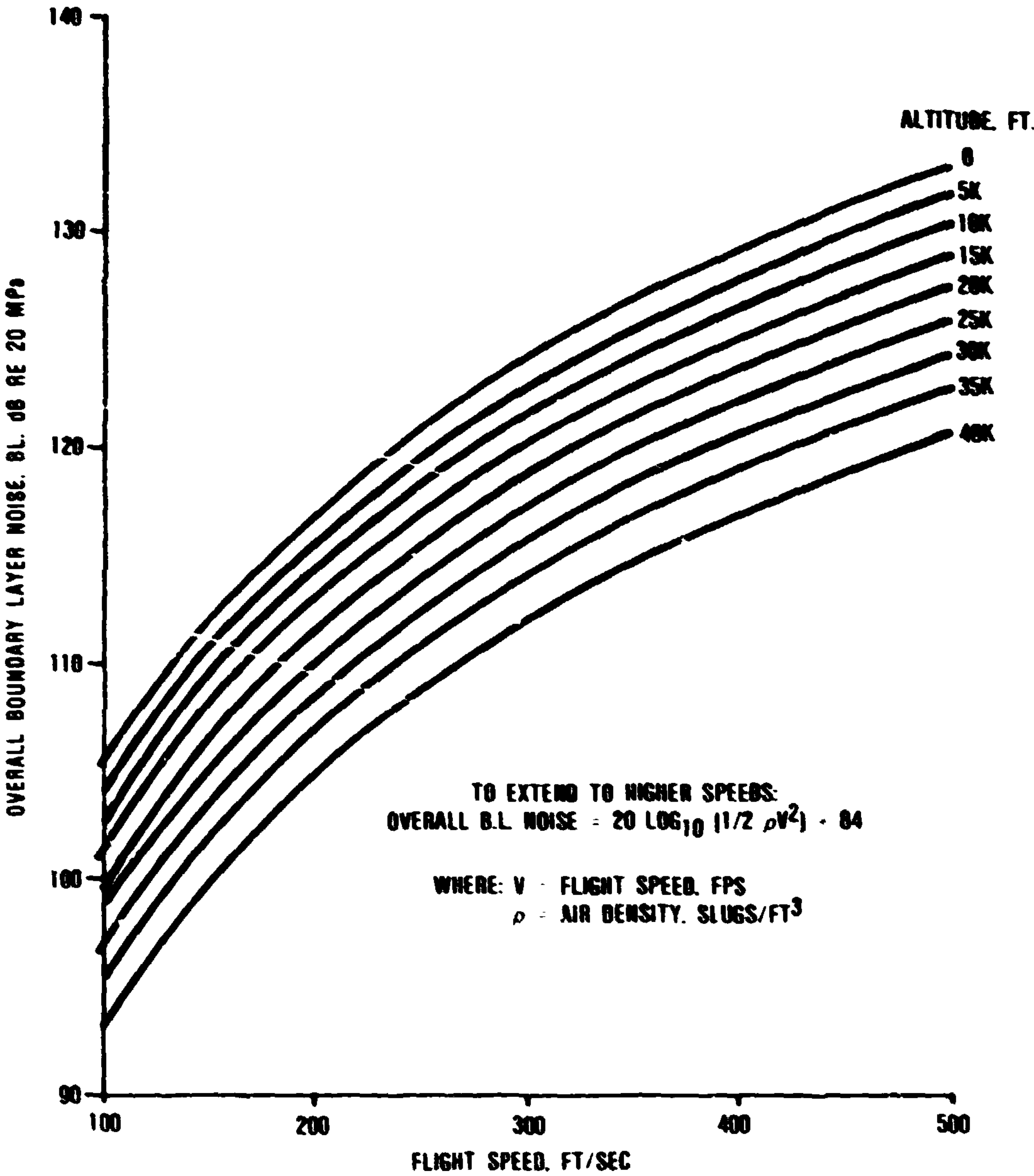

Overall Boundary Layer Noise Level
(Figure 31 from Reference 14)

Figure 13, Ap. B

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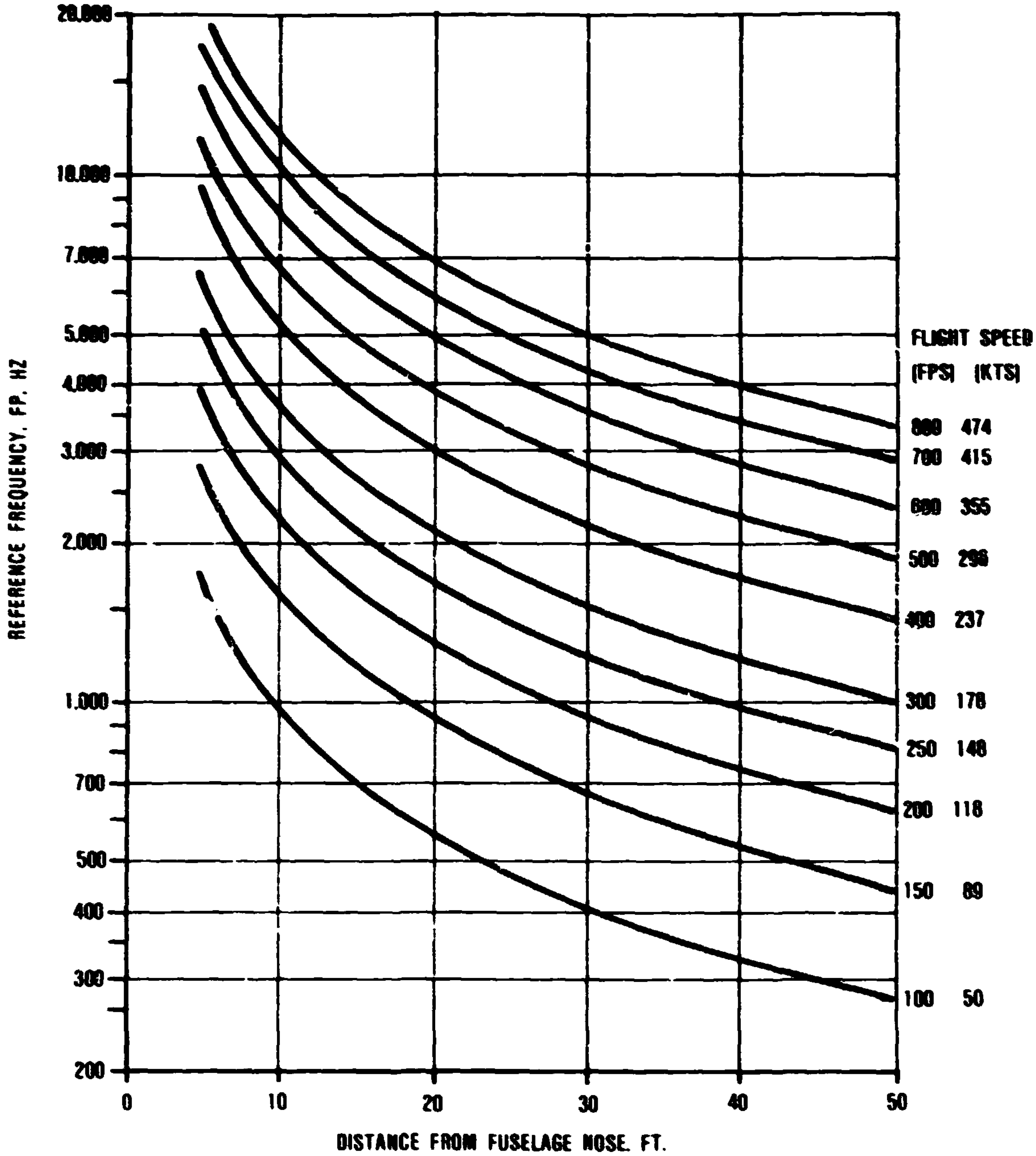

Reference Frequency, FR, for Boundary Layer Noise
(Figure 32 from Reference 14)

Figure 14, Ap. B

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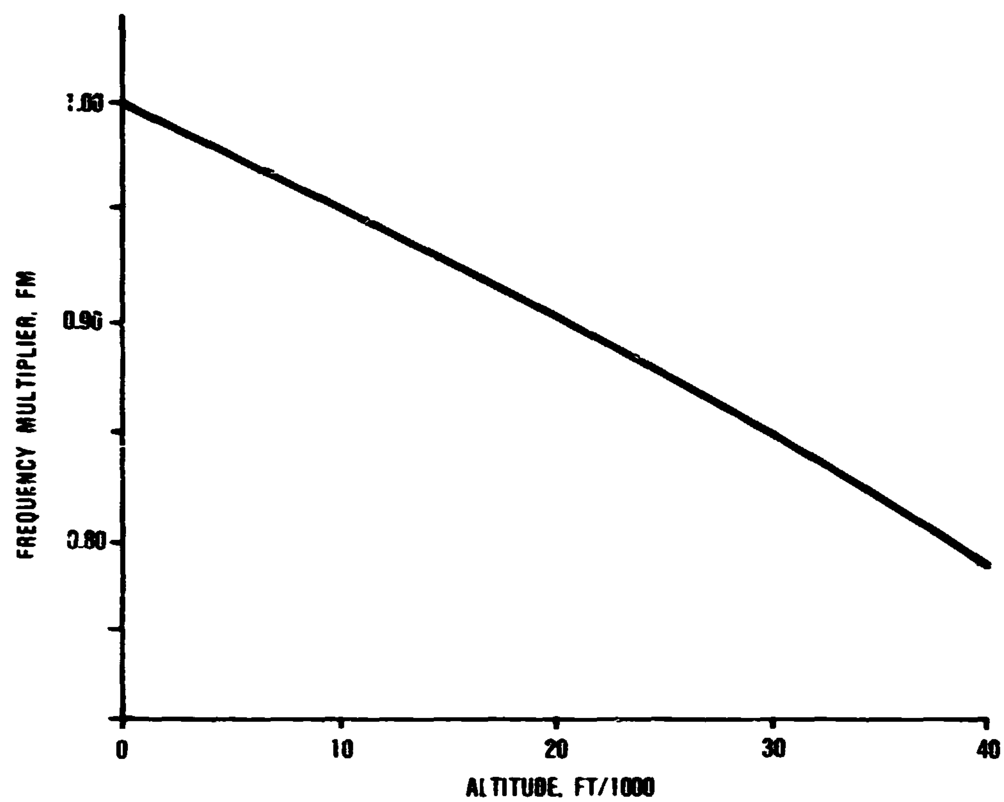

Frequency Correction for Altitude Effects
(Figure 33 from Reference 14)

Figure 15, Ap. B

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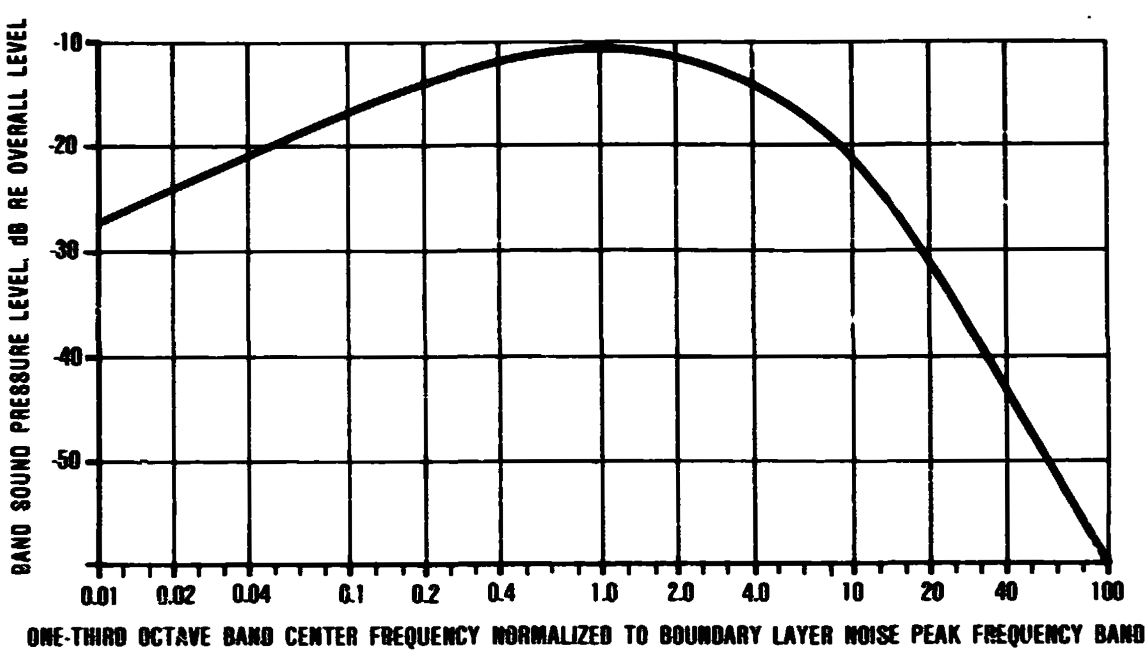
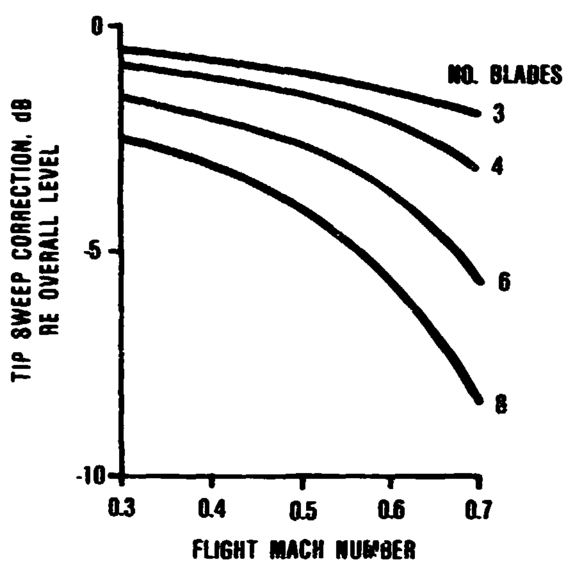


Boundary Layer Noise Frequency
(Figure 34 from Reference 14)

Figure 16, Ap. B



Near-Field Noise Tip Sweep Correction
(Figure 28 from Reference 14)

Figure 17, Ap. B

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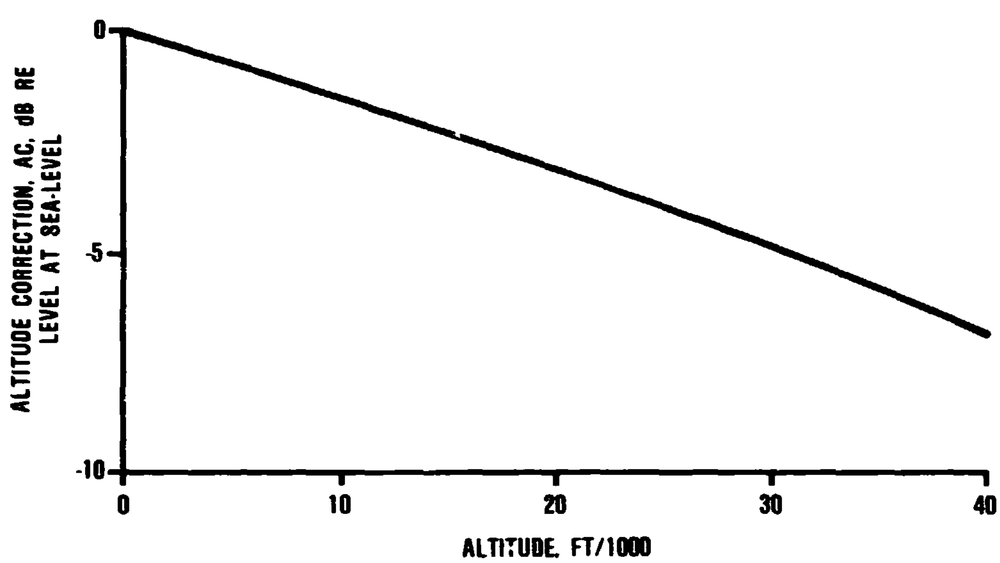

Effect of Altitude on Near-Field Propeller Noise
(Figure 18 from Reference 14)

Figure 18, Ap. B

APPENDIX C

SYMBOLS

A	Area, $m^2 (ft^2)$
ALT	Altitude, m(ft)
B	No. of rotor blades
c	Speed of sound, m/s (ft/s)
D	Diameter, m(ft)
DIAP	Propeller diameter, m(ft)
d	Distance aft of aircraft nose for boundary layer calculation for cabin noise, m(ft)
dB	Decibel, dB
f	frequency, Hz
k	Specific heat ratio
L_C	Characteristic partial sound pressure level, dB
L_P	Sound pressure level, dB
L_{PA}	A-weighted L_P, dB
L_{PN}	Perceived noise level, dB
L_{TPN}	Tone-Corrected L_{PN}, dB
L_{EPN}	Effective perceived noise level, dB
L_W	Sound power level, dB
log	logarithm, base 10
M	Mach No.
M_R	Propeller rotational tip Mach No.
M_T	Propeller reference tip Mach No.

APPENDIX C (Cont'd)

SYMBOLS

M_{TH}	Propeller helical tip Mach No.
m	Mass flow, kg/s (lb/s)
N	Fresnel number
NBP	No. of propeller blades
P	Pressure, $N/m^2 (lb/ft^2)$
P_C	Cabin pressurization, $N/m^2 (lb/ft^2)$
P_R	Pressure ratio
Q	Ground reflection coefficient
R	Source-to-observer distance, m(ft)
rpm	rotational speed, rpm
RSS	Rotor-stator spacing, percent
SHP	Shaft horsepower, hp
T	Temperature, K(°R)
TL	Transmisssion loss of fuselage sidewall, dB
V	Velocity, m/s(ft/s); also, number of stator vanes
X, Y, Z	aircraft or observer orthogonal position components, m(ft)
α	Angle of attack, deg
θ	Angle from static engine inlet to observer, deg
γ	Flight path angle, deg
β	Angle from flight engine inlet to observer, deg

APPENDIX C (Cont'd)

SYMBOLS

ϕ	elevation angle, observer to aircraft, deg
Δ	difference or correction, as in ΔdB
δ	relative tip flow angle at compressor inlet, deg; also, source-receiver path length difference between direct and diffracted sound fields, m(ft); also, phase of ground reflection coefficient; also, cutoff factor
λ	wave length, m(ft)

Subscripts

0	Ambient or aircraft
1	Fan, first-stage compressor inlet
2	Second-stage compressor inlet
3	Combustor inlet
4	Turbine Inlet
5	Turbine Exit
6	Nozzle or Diffuser Exit
BB	Broadband
bp	Blade passage
D	Design condition
i	One-third octave frequency band
oa	Overall
peak	Peak
r	Receiver or observer

APPENDIX C (Cont'd)

SYMBOLS

ref	Reference
rel	Relative
t	Rotor tip, or total
tone	Discrete tone

APPENDIX D

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